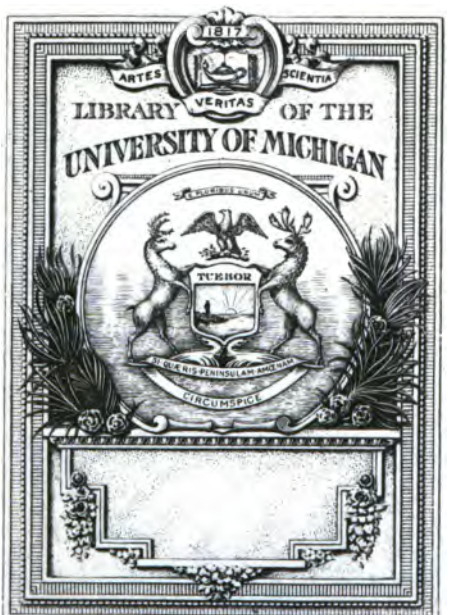
ARTES
VERITAS
SCIENTIA
LIBRARY OF THE
UNIVERSITY OF MICHIGAN
TUEBOR
CIRCUMSPICE

Locke, Richard Adams

THE CELEBRATED

"MOON STORY,"

ITS

ORIGIN AND INCIDENTS;

WITH A

MEMOIR OF THE AUTHOR,

AND

AN APPENDIX,

CONTAINING,

I. AN AUTHENTIC DESCRIPTION OF THE MOON;
II. A NEW THEORY OF THE LUNAR SURFACE,
IN RELATION TO THAT OF THE EARTH.

BY WILLIAM N. GRIGGS

NEW YORK:
BUNNELL AND PRICE,
121 FULTON-STREET.
1852.

THE

"MOON STORY,"

ITS

ORIGIN, INCIDENTS, &c.

CHAPTER I.

ITS ORIGIN

PRIOR to the conception of this remarkable and universally celebrated production, its author, Mr. RICHARD ADAMS LOCKE, had written several serial articles for the NEW YORK SUN, in which it originally appeared, that had proved eminently successful and popular. Among these were the "Memoirs," not more marvellous than true, "of Matthias the Prophet," which filled the whole civilized world with commingled wonder and indignation, at the debasing credulity and fanaticism created by the supernatural and impious pretensions of an insane but subtle impostor, which they strikingly revealed. Although almost every fact and statement contained in these "Memoirs" had been fully substantiated by the sworn evidence adduced on the trial of Matthias for the murder of Mr. Pearson, in Westchester county, New York, and had become familiar to the public through the daily and extended reports of the public

press; yet the new interest which they acquired in the superior and exciting narrative of Mr. LOCKE, caused not only an unprecedented demand for *The Sun*—then newly established—for which it was specially written, but insured a sale of the "Memoirs," in a pamphlet form, to the extent of more than *forty thousand* copies, in a few weeks.

For this article, Messrs. DAY & WISNER, the originators and then proprietors of *The Sun*, paid the author $150, with the offer of a similar sum for any contribution, of a popular tendency, which he might feel disposed to write. Shortly after this, Mr. WISNER sold out his interest in the paper to Mr. MOSES Y. BEACH, brother-in-law of the other proprietor, and the offer was urgently renewed, in connection with several new features of enterprise then introduced into the management of the establishment. While cursorily speculating upon subjects of a sufficiently novel and interesting character to enhance and accelerate the already increasing popularity of the paper, upon the terms proposed, Mr. LOCKE's choice of the topic of his renowned "Moon Story" was determined in the following manner. His course of reading for many years having been almost exclusively scientific, he was perusing, in the summer of 1835, the volume of the "*Edinburgh New Philosophical Journal*" for 1826, when, at page 390, his attention was arrested by an article from the pen of Dr. THOMAS DICK, of Dundee, the voluminous

and piously speculative writer upon astronomy, upon the possibility of corresponding with the inhabitants of the moon, by means of symbols—immense stone diagrams!—erected upon the surface of the earth. The particular passage referred to is as follows:

"Gruithuisen, in a conversation with the great continental astronomer, Gauss, after describing the regular figures he had discovered in the moon, spoke of the possibility of a correspondence with the lunar inhabitants. He brought to Gauss's recollection the idea he had communicated many years ago to Zimmerman. Gauss answered that the plan of erecting a geometrical figure upon the plains of Siberia corresponded with his opinion, because, according to his view, a correspondence with the inhabitants of the moon could only be begun by means of such mathematical contemplations and ideas as we and they must have in common."

This grave assumption, on the part of these sage astronomers, first, of the existence of inhabitants on the moon; secondly, of their possessing powers of vision, either natural or artificial, adequate to the perception of symbolical structures on the earth; thirdly, of their being rational creatures, capable "of such mathematical contemplations and ideas as we and they must have in common;" and fourthly, of their being both competent and inclined to erect symbolical edifices in reply to those constructed for them upon the earth, and without which lunar an-

swers no correspondence could be conducted—all these solemnly assumed points were too irresistibly ludicrous to escape Mr. Locke's susceptible tendency to the burlesque, and proclaimed as they were in a scientific journal of high philosophical pretensions, he deemed them fair subjects of sedate and elaborate satire.

On referring to Dr. Dick's astronomical speculations, in his various popular works—his *Christian Philosopher*, *Celestial Scenery*, &c., Mr. Locke not only found this article in the *Edinburgh New Philosophical Journal* referred to and cited, with that peculiarly pious unction for which that writer is so pre-eminently distinguished, but expatiated and moralized upon as an embryo suggestion, worthy of the highest international consideration and policy. Thus, in his *Celestial Scenery*, in commenting upon the passage above quoted, Dr. Dick seriously remarks as follows:

"Were the inhabitants of the moon to recognize such a figure, erected on an immense scale, as a signal of correspondence, they might, perhaps, erect a similar one in reply. But it is questionable whether the intention of such a signal would be recognized; and our terrestrial sovereigns are too much engaged in plunder and warfare to think of spending their revenues in so costly an experiment; and, therefore, it is likely that, for ages to come, we shall remain in ignorance *of the genius of the lunar inhabit-*

ants. Schemes, however, far more foolish and preposterous than the above, have been contrived and acted upon in every age of the world. The millions which are now wasted in the pursuits of mad ambition and destructive warfare might, with far greater propriety, *be expended in erecting a large triangle or ellipsis of many miles in extent*, in Siberia or any other country, which might, at the same time, accommodate thousands of inhabitants who are now roaming the deserts like the beasts of the forest."—p. 273.

It is unnecessary to analyze the manifold absurdity of these presuppositions and suggestions, in order to feel the pungency of its appeal to the risible emotions of every rational and scientific mind. It is only necessary to imagine a nation, or an alliance of nations, actually engaged in the work of building these immense stone diagrams, "triangles or ellipses, of many miles in extent," to open a correspondence with the inhabitants of the moon, and in patient confidence that they would build others in reply, in the absence of the slightest indication of evidence, either ocular or inductive, that any such inhabitants exist. If we could conceive it possible that the toil and treasure of any country could be appropriated to such a purpose, the only information concerning the moon that we could hope to gain from it would be a conviction of a greater degree of disturbing influence from that luminary, upon the minds of men, than is now ascribed to her; with the mitigating

consolation, however, that the authors and prosecutors of the undertaking, if not building accommodations for "thousands of inhabitants who are now roaming the deserts like the beasts of the forest," might, at least, be erecting commodious lunatic asylums for their own occupancy.

Yet such was the wild, imaginative, and ridiculous condition of popular, and, to a certain extent, even of academical, philosophy upon the subject of optics, as applied to the moon, at the time the "Moon Story" was written. And we have the assurance of the author, in a letter published some years since, in the *New World*, that it was written expressly to satirize the unwarranted and extravagant anticipations upon this subject, that had been first excited by a prurient coterie of German astronomers, and thence aggravated almost to the point of lunacy itself, both in this country and in England, by the religio-scientific rhapsodies of Dr. Dick. At that time, the astronomical works of this author enjoyed a degree of popularity, in both countries, almost unexampled in the history of scientific literature. The sale of the editions republished in this country was unbounded, until nearly the whole of his successive volumes found a place in every private and public library in the land. Yet it would be difficult to name a writer who, with sincere piety, much information, and the best intentions, has done greater injury, at once, to the cause of rational religion and inductive science,

by the fanatical, fanciful, and illegitimate manner in which he has attempted to force each into the service of the other, instead of leaving both to the natural freedom and harmony of their respective spheres.

In illustration of this allegation, it may suffice to state that Dr. Dick is among the number of those *pseudo*-scientific writers who ascribe earthquakes, volcanoes, and the violent disruptions which we observe in the stratification of the earth, as well as all hurricanes, destructive storms, and extremes of climate, to the fall of man in the garden of Eden. Indeed, he hesitates not to declare it as his opinion, that the disobedience of Adam and Eve exerted so great an influence upon the whole physical condition and relations of this planet, as to cause the present obliquity of the earth's axis to the plane of the ecliptic, and thus the severe extremity of seasons! But it is both pertinent and important to this introduction to the "Moon Story," that the reader should be relieved of all doubt concerning the spurious character of the philosophy which it ridicules, by perusing these monstrous incongruities in Dr. Dick's own words. Under the head of "The Seasons not a part of the Earth's Original Constitution," in his *Celestial Scenery*, page 122 (Harper's edition), he says:

"Man was at first created in a state of innocence, and adorned with the image of his Maker; and the frame of Nature, we may confidently suppose, was so arranged as to contribute, in every respect, both

to his sensitive and intellectual enjoyment. But neither the horrors of winter, and its dreary aspect in northern climes, nor the scorching heats and appalling thunderstorms which are experienced in tropical climates, are congenial to the rank and circumstances of beings untainted with sin, and endowed with moral perfection. Such physical evils and inconveniences as the change of seasons occasionally produces appear to be only adapted to man in his present state of moral degradation. In the primeval state of the world, it is not unlikely that *the axis of the earth had a different direction from what it has at present;* and that instead of scorching heats and piercing colds, and the gloom and desolation of winter, there was a more mild and equable temperature, and something approaching to what the poets call a perpetual spring. * * * If these remarks have any foundation in truth, then we ought not to imagine that the earth is a standard by which we are to judge of the state of other planetary worlds, or that they are generally to be viewed as having a diversity of seasons similar to ours."

And this is written by an author quoted in many of our most popular school-books as a high astronomical authority, and named as "Thomas Dick, LL. D., the eminent astronomer;" when it either is, or ought to be, known to every school-boy, that there is no planet in the solar system whose axis is not more or less oblique to the plane of the ecliptic, and conse-

quently subjected, in a greater or less degree, to those changes of seasons which are here assumed as peculiar to the earth alone, and, as a physical consequence, of moral evil! Equally well known is it to every man of science that many of the volcanic disruptions and dislocations which distinguish the geology of our planet, and which Dr. Dick and other writers of his school attribute to the same moral cause, must have occurred long prior to the race of man upon the earth, or any of the higher order of animals. Nor are these great physical convulsions peculiar to our globe. In the moon, at least, as we shall show in another part of this little work, in connection with an account of the actual character and condition of that satellite, these disruptive convulsions have proceeded upon a scale of depth and extent of which the earth affords no examples. If, therefore, the reasoning of Dr. Dick and his sect is to be admitted, it follows, by inevitable parity, that the moon is inhabited by moral agents like ourselves, who have brought down the wrath of heaven upon the very stratification of their poor little world, by some primitive act of disobedience. And it would be interesting to inquire whether this method of proving the existence of moral and rational inhabitants in the moon was not really the foundation of those immense stone diagrams, "triangles and ellipses," which Dr. Dick proposes to erect for their recognition, and as expressing "mathematical contempla-

tions and ideas which we and they must have in common;" in consequence, we presume, of our common condition as debased intelligences!

Of the moral state of the primary planets of our system, Dr. Dick is inclined to cherish higher hopes, because, while he devoutly overlooks the conflicting fact that many of them must necessarily have summers and winters, and thence storms and tempests much more severe than those of this guilty world, he cannot discover, by any telescopic power as yet devised, that they have undergone such terrific volcanic mutations. Volcanoes invariably horrify this philosopher with a deep sense of human sinfulness, and, in the absence of an ocular demonstration of their occurrence in the planets, he resolves upon the agreeable theory that every planetary population except our own is blessed with purity, piety, and peace. The idea of *night*, indeed, in any of these blissful abodes, which seems inevitable to their revolution on their axes, seems to trouble him a little at first, but he finally says (*Celestial Scenery*, page 373):—"The idea of night among the celestial bodies ought not to be associated with gloom, and darkness, and deprivation of comforts. In our world, this is frequently the case. A cloudy atmosphere, combined with the fury of raging winds, hurricanes, and the appalling thunderstorm, frequently renders our nights a scene of gloom and terror, especially to the benighted traveller and the mariner in the midst of the ocean.

But such gloomy and terrific scenes would never have taken place, had our globe and its inhabitants remained in that state of order and perfection in which they were created; and, therefore, we are to consider such physical evils as connected with the *moral state* of the present inhabitants of the earth."

The rational observer of nature takes a very opposite view of these natural phenomena, and regards physical evils (in that relative sense in which alone it can be admitted to exist) as a cause, rather than a consequence, of moral evil; and this is evidently the doctrine of the Scriptures, as taught in the allegory of "the tree of the *knowledge* of good and evil," whose fruit is poetically said by Milton to have "brought death into the world, and all our woe." The whole course of nature, from the beginning of time to the present hour, is a course of alternate production and destruction. Whatever designs, contrivances, and tendencies exist for the former are accounted good; and for the latter, evil. Yet it is evident that if this be the constitution and course of nature, as it undeniably is, then there must be as many of such designs, contrivances, and tendencies for the accomplishment of the latter object as the former; and all physical, if not, indeed, moral, evil, whether in the shape of terrestrial and atmospheric convulsions, or of bodily diseases and destructive vices, bear testimony to the reality of the fact. Such physical evils, indeed, must exist in every world

in the universe in which the necessary law of alternate production and destruction prevails, whether what is denominated "moral evil" comes in as auxiliary to the process or not.

As if to keep in countenance the imaginative religio-philosophy in which he delighted to indulge, and which is the predominant characteristic of all his writings, Dr. Dick failed not to interlard them, in relation to the moon, at least, with the kindred speculations of several European astronomers, from whose legitimate science and merited eminence the world was entitled to expect better things. Speaking of the moon, especially, he says (*Celestial Scenery*, page 272): "In reference to the subject under consideration, Dr. Olbers is fully of opinion 'that the moon is inhabited by rational creatures, and that its surface is more or less covered *with a vegetation not very dissimilar to that of our own earth.*' Gruithuisen maintains that he has discovered, by means of his large achromatic telescope, 'great artificial works in the moon, erected by the lunarians!' (For who else could have erected them?) And lately, another foreign observer maintains, from actual observation, that 'great edifices do exist in the moon.' Indeed, one of these observers (Schroeler, we believe), had insisted upon his discovery of regular *fortifications* upon the lunar surface, exhibiting scientific principles of defence against artillery and assault almost identical with those improved constructions adopted

by civilized nations in recent times. And another astronomer ventured upon the still further marvel that *great national roads*, possessing the directness and regularity of railroads, were so distinctly traceable in several lunar districts, as to leave no doubt of their true character and purpose.

In order to invest these imaginary discoveries with some degree of plausibility, and adapt them to general comprehension and belief, it was necessary to give some account of the optical improvements and powers by which they could be accomplished. Accordingly, Dr. Dick furnishes his readers with all the information concerning the construction and capacity of telescopes that can be deemed necessary to any conceivable result. In the work already quoted, he says (page 271): "But although we may never *see* any of the inhabitants of the moon by any instrument constructed by human ingenuity, yet we may be able *to trace the operations* of sentient or intelligent beings, or those *effects* which indicate the agency of living beings. A navigator who approaches within a short distance of a small island, although he perceives no human beings upon it, can judge with certainty that it is inhabited, if he perceive human habitations, villages, corn-fields, and other traces of cultivation. In like manner, if we could perceive changes or operations in the moon which could be traced to the agency of intelligent beings, we should then obtain demonstrative evi-

dence that such beings exist on that planet; *and I have no doubt that it is possible to trace such operations.* A telescope which magnifies 1200 times will enable us to perceive, *as a visible point*, on the surface of the moon, an object whose diameter is only about 100 yards, or 300 feet. Such an object is not larger than many of our public edifices; and, therefore, were any such edifices rearing in the moon, or were a town or city extending its boundaries, or were operations of this description carrying on in a district where no such edifices had previously been erected, such objects and operations might probably be detected by a minute inspection. Were a multitude of living creatures moving from place to place in a body, or were they encamping in an extensive plain, like a large army, or like a tribe of Arabs in the desert, and afterwards removing, it is possible that such movements might be traced by the difference of shade or color which such movements would produce."

So thoroughly was the popular mind, even among the best educated and most reading classes, imbued with these fanciful anticipations of vast lunar discoveries, and of speedy telescopic improvements by which they were to be assuredly achieved, that, at the time Mr. Locke's "Moon Story" was written, scarcely any thing could have been devised and announced upon the subject too extravagant for general credulity to receive. To every observant advocate of legitimate science and authentic knowledge, this

humiliating state of things must naturally have seemed to demand some pointed and practical reproof, to effect its exposure, correction, and reform. Educated in the strictest school of mathematical and inductive science, zealously devoted to its studies and pursuits, and, at the same time, as we have already intimated, holding an influential connection with a new and vigorous branch of the public press, then rapidly acquiring an unprecedented breadth of popularity, Mr. Locke was precisely the writer to check so mischievous an epidemic of imaginative and spurious philosophy, by a well-timed satire, "outheroding Herod" in its imaginative creations, supplying to satiety the morbid appetite for scientific wonders then universally raging, and, at the same time, maintaining a pretty firm grasp upon the credulity of nearly all but thoroughly taught minds, by its plausible display of scientific erudition.

Thus every thing favored the conception and its execution; and, as is well known, it was crowned with an imposing splendor of success, altogether unexampled in the history of literature. Even the accessories of the satire—such as the peculiar construction of the telescope with which its amazing lunar discoveries were said to have been made—had obtained a previous approval and prepossession in the public mind; for Dr. Dick, in the appendix to his *Christian Philosopher*—a work that had been for many years enthusiastically popular among the re-

ligious community of every denomination, and which had thence become universally familiar—describes a telescope of his own invention, called "The Aerial Reflector," on which he had expended the labor of some eighteen years, and from which he confidently anticipated greater results, from lunar exploration, than he could modestly venture to detail. His mind, however, was evidently so full of the fruits of the future harvest it was to reap, that, as we have seen, its garners were bursting at every aperture. He could not, for instance, even speak of the old topic of lunar volcanoes without remarking (*Celestial Scenery*, page 265), that "such luminosities in the moon may possibly be of a phosphoric nature, or *a mere display of some brilliant artificial scenery by the inhabitants of that planet.*" This wondrous telescope —"the Aerial Reflector"—was so called, because it was constructed upon the novel plan of a lens and reflectors merely, without any connecting tube; and its focal objects could be deliberately observed and studied in a private apartment, like a portfolio of drawings, or the objects of a parlor microscope.

In these circumstances, as stated by Mr. Locke himself, in the publication to which we have referred, we have the origin, the motive, and the application of the "Moon Story," and at least one important suggestion towards the peculiar and potent telescope by which its mighty discoveries were said to have been made.

CHAPTER II.

ITS INCIDENTS.

THE title of this remarkable satire was the following:—"*Great Astronomical Discoveries lately made by* SIR JOHN HERSCHEL, LL. D., F. R. S., &c., *at the Cape of Good Hope*," and it was announced as being "first published in the New York Sun, from the *Supplement to the Edinburgh Journal of Science*." In pretending that it was copied from a periodical of this title the author committed an oversight which, if it had not also been made by the public in general, would at once have proved fatal to the credibility of the whole story, and instantly have exposed it as a hoax. "The Edinburgh Journal of Science" had, for several years, ceased to exist; and had been succeeded by the "Edinburgh New Philosophical Journal," in which Mr. Locke read Dr. Dick's article on lunar discoveries, which we have already mentioned and quoted from as the one which first suggested the burlesque. The author, no doubt, *designed* to cite the existing periodical last named as the original source of the production, and his naming the previous one which had become defunct, was purely an accidental blunder. But, strange to say, this perilous error remained undetected and unexposed by the public press, not only of this country, but of

England, until the story had run its full career of credibility, wonderment, and fascination, on the mere strength of its own ingenuity and overwhelming resemblance to reality. "The Edinburgh New Philosophical Journal" was then, as it is now, on the table of every library reading-room in the country, and the author was, of course, too shrewd to attribute his invention to any regular issue of that work. He therefore naturally referred it to a "supplement," and added, as we believe, the "Journal of Science," instead of the "Philosophical Journal," in hurried mistake. The public mind, however, was too completely captivated and absorbed with the story itself, to test its authenticity by any Journal or Supplement from which it purported to be derived, and scarcely any oversight on the part of the author would have checked the voracious credulity with which it was received—so thoroughly had the public mind been prepared to expect discoveries of this kind by the predominant school of religious philosophy, exemplified in the previous pages of this introduction

The publication of the "Great Astronomical Discoveries," was commenced in the *Sun*, in September, 1835, before any considerable number of the series had been written, and as there could be no valid excuse for intermitting, for a single day, the publication of discoveries of such unprecedented interest, when a full and authentic account of them was ad-

mitted to be in the possession of the publishers of the paper, the author was compelled to write the greater number of the successive portions as a daily task, amid the distracting avocations and interruptions of an editorial office. And this fact may be deemed fully adequate to account for whatever inadvertencies in the structure and style of the story deliberate criticism may detect.

Under this hazardous responsibility, but with evident confidence in the ability and promptitude of the author, the eager publishers cut loose their gay and gallant balloon to the public gaze; and no aerial vehicle ever performed a more illustrious or extensive voyage, for it maintained its wondrous flight until it had accomplished the entire circle of the globe, and had filled every civilized nation, in succession, with enthusiastic astonishment and delight. It was in vain that the "knowing" few, in every country, pronounced it a hoax—a mere balloon. The vast majority, even, of the intelligent and educated classes, like the astronomer in Hudibras, after his intense telescopic scrutiny of the lantern flying at the tail of a kite, decided, with an almost devotional confidence, that it was a veritable celestial luminary.

The late Edgar A. Poe, in an extended criticism upon this story and its author, in his series of biographical reviews, entitled the *Literati*, remarks that "not one person in ten discredited it, and (strangest point of all!) the doubters were chiefly those who

doubted without being able to say why—the ignorant —those uninformed in astronomy—people who *would* not believe, because the thing was so novel, so entirely out of the usual way. A grave Professor of Mathematics, in a Virginia college" [Poe was at that time editing the *Southern Literary Messenger*, at Richmond, Va.] "told me, seriously, that he had *no doubt* of the truth of the whole affair! The great effect wrought upon the public mind is referable, first, to the *novelty of the idea;* secondly, to the fancy-exciting and reason-repressing character of the alleged discoveries; thirdly, to the consummate tact with which the deception was brought forth; fourthly, to the exquisite *vraisemblance* of the narration. The hoax was circulated to an immense extent—was translated into various languages—was even made the subject of (quizzical) discussion in astronomical societies—drew down upon it the grave denunciation of Dick (whose school was the real object of it, as a satire)—and was, upon the whole, decidedly the greatest *hit*, in the way of sensation—of merely popular sensation—ever made by any similar fiction, either in America or Europe."

By the afternoon of the day on which the introductory portion of it only had appeared, not a copy of the paper could be procured at any price, notwithstanding a very large extra edition had been provided, in anticipation of an unusual demand. This was increased from day to day, until the utmost

capacity of the steam cylinder-press failed to afford an adequate supply. The office was besieged by thousands of applicants, from dawn till midnight, during the entire week the publication occupied; and although there was to be heard among the crowd some occasional intimations of skepticism, from persons of the class described by Mr. Poe in the above extract, yet the almost universal impression and expression of the multitude was that of confident wonder and insatiable credence. Some of the incidents of the street discussions, on this occasion, were extremely remarkable. The editor of this new edition well remembers being present at the door of the *Sun* office, one morning, when a highly respectable-looking elderly gentleman, in a fine broadcloth Quaker suit, completely dispelled the undecided opinions of the listening crowd around him, by asserting, in the calmest, coolest, and most unquestionable manner, that he was fortunately engaged on commercial business at the East India Docks, in London, when the vast lens, of seven tons weight, and the whole gigantic apparatus of the telescope described in the story, was taken on board an East India ship, for erection at the Cape of Good Hope, and that he himself saw it craned on board. He added that the statement in the introductory part of the narrative, that this shipment was made from St. Catherine's Docks, was, therefore, evidently an error on the part of the Edinburgh writer; and he concluded his corroborative

testimony with the complacent remark, that although high expectations existed at that time of the success of this enormous instrument, in the hands of an astronomer and optician like "John Herschel," yet, for his own part, he had never presumed even to hope that it would ever be the means of such marvellously minute discoveries as were now proclaimed.

The then unknown author of the story was among the immediate listeners to this venerable witness's testimony to the truth of his conscious fiction, in company with Dr. David L. Rodgers, the eminent surgeon, and several other friends, who will doubtless recollect the circumstance; and we can now readily interpret the look of mingled astonishment and contempt with which he regarded him. He, however, asked the speaker no questions, but maintained the imperturbable passivity and reserve which his temporary *incognito* required. On another occasion, at the same place, a person of perfectly respectable appearance boldly asserted that he was in possession of another copy of the Edinburgh "Supplement," from which the *Sun* was publishing its daily extracts; and he felt bound to state that, thus far, they had been faithfully made from the original and authentic narrative, without any addition or alteration whatever. Whether this decisive deponent was beguiled into this unblushing falsehood by the impulses of an enthusiastic credulity, or was merely an impudent wag, we cannot undertake to determine;

but similar instances of spontaneous mendacity, relative to the authenticity of the "Great Astronomical Discoveries," were by no means uncommon, during the excited controversy and partisanship which prevailed during its first publication; and we have heard of many other instances, not coming within our own immediate knowledge, of the most outrageous and humiliating character. Doubtless the history of every controversy, not excepting the most religious, historic, literary, and scientific, would abound with them. We know this to have been the case in regard to the Macpherson forgeries of Ossian, the Chatterton forgeries of Rowley, and the Ireland forgeries of Shakspeare; to say nothing of the controversies of the present day concerning the water-gas of Payne, and the respective characters of our rival political candidates. Indeed, comparatively few men, under the obvious influence of excessive controversial excitement, seldom retain enough moral firmness and dignity to maintain a rigid adherence to truth; and religious history, which ought to be the most exempt from such examples, will be found to be the most overgrown and inextricably entangled with them. Indeed, the degree of excitement may generally be assumed as the true measure of the amount of mendacity to which it is liable, and with which it is actually accompanied.

By the last day of the publication of the "Moon Story" in detail, the publishers, with a keen eye to

business, had the whole ready in a pamphlet form, and twenty thousand copies were sold almost instantly, in the city of New York alone, notwithstanding almost every journal, daily and weekly, presented the greater part of it to their numerous readers. Then followed large and many editions for country circulation, accompanied with several lithographic prints of unusual dimensions, illustrating the principal points and objects in the new revelations of lunar scenery; and these, like the pamphlet, sold with unexampled rapidity. In the mean time, the author, as editor of the *Sun*, must have suffered severely from the determined inquisitiveness of which he was necessarily the object, and which he is said to have in vain attempted to obviate and repel by the legitimate excuse of arduous avocations. He must inevitably have been embarrassed in the dilemma of either sustaining a literary fiction by personal assurances amounting to a conscious falsehood, or of violating a business contract by exposing a secret no longer, in honor, at his own disposal. Under this difficult alternative, as he assured us many years since, he forbore to express any opinion upon the subject, saying that, by arrivals from Europe, the question must necessarily be settled in a very short time; and that, meanwhile, it would be prudent to suspend any confident opinion one way or the other. But arrivals from Europe were less frequent seventeen years ago than now, and an answer of this kind

served rather to tantalize than to satisfy the impatient curiosity in which his interrogators indulged.

A party of professors from one of our most eminent colleges were among the number of inquirers, who, on receiving this sort of answer, asked him pointedly whether he himself had seen *the original copy* from which the daily extracts in the paper were being made; without, however, evincing the slightest suspicion that he was the secret author. On assuring them, unhesitatingly, that he had, they begged to know whether *they* could be favored with a sight of it, in order to settle some doubts which had arisen among them as to its European origin. He promptly replied that the original copy was not then in his possession, but at a printing office which he indicated across the street, where it was being set up in a pamphlet form, for publication at the close of the week; and referred them to the proprietors of the paper in the publication office, for the accommodation they desired. After some further conversation, in which the author appeared as ignorant of the whole subject as it was reasonable for any man to be, the learned inquisitors, who had thus put him to the rack, released him from torture by bidding him good morning, and seeking an interview with the proprietors. But these "wide-awake" men of business "smelling a rat," or, in other phrase, suspecting "spies in the camp," while they politely referred them to Mr. F——'s job printing office, on the oppo-

site side of Spruce-street, took good care to forestall their inquisitorial visit by a private messenger, occupying their attention, in the mean time, with inquiries concerning their conversation with the editor; so that by the time they called at Mr. F——'s, to see the "original," that great curiosity was nowhere to be found; the compositors were not at work on it, and the foreman was *non est inventus*. And thus the exploring expedition of these sages was rendered fruitless.

It is not to be supposed, however, that any fiction of this kind could long remain before an intelligent community like ours, without a public exposition of its true character. It was soon very generally denounced as "a hoax" by the public press, but not until nearly every press in the country had become its captivated victim. And even this denunciation was for a long time popularly regarded as a mere matter of opinion, for it was entirely unsustained by external circumstantial evidence, while the internal evidence was too scanty, and of too recondite a texture, either for editorial use or popular appreciation. We remember that the most prevalent editorial argument against the credibility of the story, from internal evidence, was, that it was an "established scientific impossibility to magnify a shadow," than which no assumption can be more fallacious, since every man wearing spectacles well knows that the shadow of any object projected upon any surface

whatever is equally magnified with the body which it represents, and from which it is derived. And this was Mr. Locke's great principle of mystification. It will be seen, on reperusing his description of the new Herschel telescope, that he magnified the shadow or "focal object" of his mammoth lens, as projected upon a receiving screen, or tympan, like that of a camera obscura, by means of a hydro-oxygen microscope of almost unlimited power, and in the same manner that the solar picture in a daguerreotype may be indefinitely magnified, developed, and rendered more exquisitely distinct, by means either of that or any other magnifying instrument. In fact, the optical process suggested in this part of the "Moon Story," with some slight modifications, and so far as its mere magnifying and "distinctifying" functions are concerned, remains unexploded, and open to experiment to the present hour. Indeed, it is honestly entitled to consideration, in many respects, as an anticipation, to no small extent, of the daguerreotype discovery, for it teaches the important principle, now fully verified, that focal objects, whether permanently fixed, or merely transient, after being received on any surface, may be further magnified, and rendered, at the same time, more distinct, when exposed to additional or artificial light. The realization of this fact, in relation to the telescopic image, is a *desideratum* in optical astronomy worthy of the profoundest research; and it is not surprising

that its plausible assumption in Mr. Locke's "Moon Story" should have taken even scientific men by surprise, and found them unprepared with an immediate refutation of its possibility. The chief error standing in connection with it, and which was at once obvious to all men of true optical science, was the alleged preservation of the *colors* of the focal spectra, or images, of the original objects, after they had been subjected to artificial light, and a second time magnified, without receiving any additional light from the objects themselves, from which alone their colors could have been derived. But our editorial critics fathomed none of these valid objections; and those few men of science to whom they were apparent and palpable enjoyed the ingenious joke too richly to interfere with it, even if they had been disposed to condescend to its formal refutation.

But it is by no means certain that the author ever intended his imaginative discoveries to operate upon the public mind as a hoax. Indeed, it is familiarly known to his private friends, that when he found his narrative was really received in this manner, he expressed much disappointment and chagrin, saying—"If the story be either received as a veritable account, or rejected as a hoax, it is quite evident that it is an abortive satire; and, in either case, I am the best self-hoaxed man in the whole community." When, however, it became generally construed, or rather misconstrued, as an intended hoax, the greater

part of the public press throughout the country freely admitted the high ability of the author, whoever he might prove to be; and many eulogized him as one of the most inventive, accomplished, and brilliant writers of the age. Others, less generous, denounced him, with equal vehemence, as a *charlatan* in science, and impostor in principle, deserving unmitigated execration. But it was not immediately that the author's name was known in connection with it. This was first announced by Mr. James Gordon Bennett, then, as now, the lynx-eyed editor of the *New York Herald;* and we remember that one of the points of evidence which he adduced, in corroboration of his disclosure, was, that Mr. Locke, shortly before the publication of his lunar discoveries, had held a private conversation with him on the subject of optics, in which many of the novel principles developed in the "Moon Story" had been freely discussed. To this statement Mr. Locke replied, the same day, in a short letter which appeared in the *Evening Star*, in which he denied not exactly, like Sir Walter Scott, the entire authorship imputed to him, but that he had "made those discoveries," which he doubtless hoped would produce the same effect as a positive denial, in an absolute and categorical form. He further denied that he had at any time held a conversation with Mr. Bennett on the subject of optics; and, in illustration of the intrinsic improbability of his having done so, he closed his very

brief letter by a peculiarly touching appeal to public candor, saying—"Only think of two editors of rival journals, squinting so curiously and contradictorily as we undeniably do, meeting in private, by special appointment, to put our noses together, and discuss optics!" This appeal to public risibility was worth a thousand grave arguments and asseverations; and our author having thus got the popular laugh on his side, left the question of authorship to its own fate on the tide of events.

In the course of a few weeks, there was an arrival of mails from Europe, which, instead of exposing and exploding these "great astronomical discoveries, lately made by Sir John Herschel at the Cape of Good Hope," as had been confidently predicted, seemed at once to substantiate and confirm them! The English and French journals were full of them; and in no instance, by *that* arrival, were they attributed to an American source! This was marvellous; the champions of the "Moon Story" marched with high feathers, and regarded their skeptical opponents with pity and contempt. The only cloud which in any degree threatened the splendor of their triumph, appeared feebly and obscurely in some of the leading French journals, and for this they cared but little, especially as it seemed to escape the notice of their adversaries. The *Constitutionnel* and some other Paris papers contained reports of an elaborate and energetic debate in the French Academy of Sciences,

occupying several columns, upon the authenticity and credibility of the alleged lunar discoveries at the Cape of Good Hope. The illustrious and venerable Arago, the President of the Academy, invited the grave attention of his learned associates to the subject, inasmuch as the Edinburgh publication, purporting to be an authentic report of these extraordinary discoveries, appeared to be a wanton and malevolent attack upon his illustrious friend, Sir John Herschel, who, of all men living, ought to be regarded as sacred from the assaults of ridicule, and whom it was the solemn duty of that body to protect from its envenomed shafts. He was at that moment, and had been for years, engaged in enormous and, doubtless, immortal labors in the cause of science, and thence of mankind, in a remote region of the earth; and it was most atrocious that he should be subjected to the deliberate ridicule, and those labors to the elaborate burlesque, of this pretended report of them. That he (Arago) was not mistaken in this view of the character and object of this publication, would be evident from the translation of it which he held in his hand, and which he begged permission to read to them.

Accordingly, it was read to the assembled academicians, from beginning to end, amid repeated interruptions from uncontrollable and uproarious laughter, which the venerable President, who is represented as evidently sincere in his indignation, vainly

endeavored to suppress. After an irresistibly comic debate, in which Frenchmen so well know how to indulge, and which was protracted to an extent most unusual in such a body, they gravely adopted the resolution, more exquisitely comic than any other they could have passed, that although the alleged lunar discoveries were not to be regarded as a malicious attack upon the illustrious astronomer to whom they were ascribed, yet they must be pronounced by that body *utterly incredible!*

This absurd serio-comic scene in the Academy of Sciences afforded a perfect harvest to the Parisian caricaturists, who filled the print shops with their ludicrous and satirical productions upon the subject. It was even hit at in the vignettes to pieces of music. Stray man-bats from the moon were depicted sitting in woeful plight under the dripping offices of the Boulevards; while others, who had evidently been imbibing drops of something more comfortable, were to be seen in the custody of *gens d'armes*, singing jolly ditties to the tune of "*Le clair de la Lune.*" But in order to account for the absence of all allusion to the New York origin of the lunar discoveries at that time in the French and English journals, it may be necessary to state that the shrewd proprietors of the *Sun* had caused numerous copies of the pamphlet, without any American imprint or indication, to be dispatched, through resident agents, to all the principal papers in London, Edinburgh, and Paris; and

although they doubtless received detached and fragmentary extracts of the story in the American papers, at the same time they naturally preferred copying it from the pamphlet, where it was presented entire, to the labor of selection and compilation. So that whether they were hoaxed themselves or not, they too well knew the value of the narrative, as matter of interest to their readers, to expose its American origin, even if they were really apprised of it. As evidence of this conclusion, even the Edinburgh papers, where it must instantly have been known as a hoax, published it with all the gravity and reserve of a synod or council of sages.

From England and France these glorious and astounding discoveries sped their welcome way through Germany, Italy, Switzerland, Spain, and Portugal, and were translated into all the languages. We have recently been assured, in the most serious manner, that in many of the interior parts of Germany, and of the Continent generally, they remain uncontradicted to the present day, and are believed, like sacred and delightful truths, by vast numbers of the population. Of all people, however, the Italians appear to have been the most heartily amused with them; and we have seen numerous large lithographic prints that were brought from Naples by one of our naval officers, in which the lunar scenes and inhabitants, as described by the imaginative author, are depicted in exaggerative and comic association, with

infinite skill and humor. In our own grave country, the effect was less lively, and took rather a religio-comic turn; in ridicule of which, the celebrated Miss Martineau, who was travelling in the United States at the time, declares, in her "Sketches of Western Travel," that the effect of the "Moon Story" upon the ladies of Springfield, Mass., was to induce them, with all speed, to set going a liberal subscription towards sending *missionaries* to that interesting but benighted luminary, for the conversion of the man-bats—a proposition, it must be confessed, but little less practicable or hopeful than that of Dr. Dick for accomplishing the same object, by demonstrating to them the truths of Christianity in a series of geometrical diagrams, exhibited in immense structures of stone.

In New York and other principal cities, as also in those of Europe, these burlesque lunar discoveries were at length rendered a source of public amusement, by various methods of scenic representation. The ingenious Hannington exhibited the best scenes of the story in a series of beautiful dioramas, which were highly popular; and the subject was very effectively dramatized at the Bowery Theatre, in a gorgeous comic spectacle. But the chief and most general amusement which it afforded, and, to some extent, still affords, was in domestic and social conversation between those who professed to have been too wise and wary to be deceived, and those who

frankly avowed their entire credulity. Among the latter were many of the best educated persons in the community, who still find amusement in rallying a long list of fellow-victims in the circles of their acquaintance, and in relating innumerable anecdotes illustrative of the common epidemic of enthusiastic credence which for a while prevailed.

But we cannot close this cursory glance at the incidents attending this remarkable production without including that of its first reception by Sir John Herschel himself, at the Cape of Good Hope. It was presented to him personally, both in the New York papers and in the pamphlet form, by Mr. Caleb Weeks, of Jamaica, Long Island, on his visit to the Cape, for the purpose of obtaining giraffes and other rare animals from the interior of South Africa, for the magnificent menagerie of which he was then a proprietor. It appears that the illustrious astronomer was in the habit of seeking relaxation from his severe labors and studies at his observatory, in almost daily visits to Cape Town, where, in the back parlor of a snug hotel, he obtained the earliest news from Europe and America, and enjoyed his English pipe. One of Mr. Weeks' first inquiries, on his arrival at the same hotel, was as to where Sir John Herschel could be found in that vicinity, and he was delighted to receive the answer that the renowned astronomer was then in the house, and would, no doubt, from his known affability, cordially receive any gentleman

from the United States who might wish to see him. On being introduced to him, Mr. Weeks, who is well known as a wag both of extraordinary gravity and hilarity, said he begged the honor of presenting him with the American report of his "great astronomical discoveries." Sir John replied, with an air evincing some surprise, that he should feel much obliged for any information from the United States; but of any thing relating to himself or his astronomical pursuits, he could not readily conceive, inasmuch as he himself had made no report upon the subject. Mr. Weeks confidently remarked that it must, nevertheless, have "got wind" in some way or other, for here was the "full and particular account" in print, "and no mistake"—at the same time presenting him with Mr. Locke's pamphlet and files of the New York papers, and then bowing himself out of the parlor. Rejoining the party composing his expedition, in the public room, Mr. Weeks quietly observed that if the astronomer, great as he was said to be, didn't learn more about the moon than he ever knew before, he must be "a darnation smart man." But in a few minutes Sir John appeared there himself, and, addressing Mr. Weeks in a tone of excited interest, said—"This is a most extraordinary affair! Pray, what does it mean? Is this really a reprint of an Edinburgh publication, or an elaborate hoax by some person in New York?" To these rapid interrogatories Mr. Weeks replied that he "really couldn't say.

All that he knew about it was that every word of the story was taken for gospel in New York, and throughout the United States; and it was a maxim, that 'what everybody says must be true.'" At this Sir John laughed very heartily, and inviting Mr. Weeks and his friends to a more private room, requested them to state the popular effect which the narrative had really produced. With the description which Mr. Weeks gave him, and which was, no doubt, full of the exquisite dry humor for which he is so well known, the learned astronomer was incessantly and uncontrollably astonished and amused; and he renewed his inquiries from day to day, as long as Mr. Weeks remained in the town—directing them particularly towards the author, and his reputation, in other respects, as a writer. In one of these interviews he good-naturedly remarked that he "feared the actual results of his telescopic observations at the Cape would be very humble, in popular estimation, at least, in comparison with those ascribed to him in the American account, as he was unfortunately unprovided with any such instrument as it admitted to be necessary to achieve them." And he was particularly amused with that satirical point in the story which stated that he had been indebted for that stupendous instrument to the royal munificence of the late William IV., when it is well known that Sir John Herschel undertook and sustained his scientific expedition to the Cape, with all its expen-

sive instruments and attendants, with his own private means, and without any assistance whatever from the government. And to this fact it should now be added, in justice to his high-minded and disinterested motives, that when, after an absence of four years, he returned to England, rich only in the immortal honor of his unexampled labors—the complete and exact survey of the whole southern celestial hemisphere—the government of the Queen offered him a full pecuniary indemnity for his expenses, he respectfully declined to accept it.

CHAPTER III.

MEMOIR OF THE AUTHOR.

THE editor of this edition of the "Moon Story" deems it but candid to state that he has had no materials for the present biographical notice of its author than the meager generalities that have appeared in connection with previous editions, except such as he has collected from the periodicals of this country and Europe during the last few years, and from the private information of literary friends. He believes that the author himself has as yet furnished no contributions towards his own biography, except such as may have been incidentally mentioned, without any such ulterior design, in private conversation. From

these, however, it has been ascertained that his literary life has been much more prolific and diversified in its productions than is generally supposed.

Of English parentage and education, but American birth, Richard Adams Locke is a descendant of an old and respectable family in the west of England, and a collateral descendant of John Locke, the founder of the modern philosophy of the "Human Understanding." Mr. Edgar A. Poe, in his literary memoir of Mr. Locke in *Godey's Magazine*, erroneously states that he is lineally descended from that eminent philosopher; but it is well known that the latter never married, and our author is a grandson—the fifth in descent of the same baptismal name—of the philosopher's father's brother. Both his father and grandfather were men of letters—the latter being the historian and antiquarian of several of the western counties of England, and of the "Western Rebellion," so frequently cited by Macaulay in his recently issued history of the same period. His father, though a graduate for the church at the university of Oxford, preferred the profession of arms, and served in Canada in the corps of Royal Engineers, and subsequently in other regiments throughout the Peninsular war, until the battle of Waterloo.

Our author was born shortly after the commencement of the present century, and his education was chiefly conducted by his mother until his fourteenth year, although he commenced his classical studies

four or five years earlier. His first literary efforts are said to have been amatory verses to young ladies of his own age, which then scarcely exceeded twelve or thirteen, and some of these effusions were deemed good enough for publication in provincial periodicals. By his eighteenth year, and shortly before he became a student at the University of Cambridge, he had completed a poem, in six cantos, of nearly a thousand lines each, entitled "The Universe Restored," and illustrating the novel theory of the alternate destruction and reproduction of all things throughout the universe of space. A few years afterwards he is favorably noticed as a contributor to the *Imperial Magazine*, edited by the celebrated Samuel Drew, the metaphysician; and also to the *Bee*, a Liverpool periodical. In the former, his pen was chiefly devoted to Italian history and biography; and in the latter to miscellaneous literature. After leaving college, where he graduated for the Established Church, without taking orders, he modified his religious opinions, and wrote extensively in behalf of the most ultra doctrines of Unitarianism and Universalism, in connection with the most republican principles. He was the projector of the London journal called the *Republican*, and for some time its principal writer. After this unsuccessful effort to indoctrinate the British people with the principles of American democracy, he reverted to literature and science, started a monthly magazine called the *Cornucopia*,

and for six months wrote the whole of it himself—essays, critiques, sketches, philosophy, poetry, and science, physical and psychological. He then became a champion of Catholic emancipation, and at the same time an opponent of the temporal power of the Pope. The latter subject, involving a retrospect of the history of the Catholic church, led him into a weekly controversy with several able clerical writers of that faith, which continued for nearly two years, in a provincial journal, the *Somersetshire Herald;* but he never relinquished his advocacy of the political claims of the Catholics until he saw them triumph. Meanwhile he found time to contribute many articles to the principal Reviews and Magazines, besides much encyclopædic matter for various publishers.

Shortly after this he permanently settled in New York, first becoming connected with the *Courier and Enquirer*, then the leading democratic journal. But this engagement was of brief duration; and he wrote and published, in connection with Mr. Henry A. Wheeler, of Washington, the "History of the Polish Revolution," then a subject of the most exciting interest. From this period he became actively identified with the daily press of the city, until, in 1835, we find him editor of the *Sun*, and the world-renowned author of the "Moon Story." Of this production, in relation to its influence upon the establishment and prosperity of the cheap daily press, then in its earliest infancy, the late Mr. Poe

has said:—"Its success firmly established the new system throughout the country, and *through* the *Sun*. Consequently we are indebted to the genius of Mr. Locke for one of the most important steps ever taken in the pathway of human progress."

In the fall of the following year, Mr. Locke started and established the *New Era*, which, while it remained under his control, was one of the most distinguished and influential democratic journals in the whole country; and it has been succeeded, at least in the city of New York, by no other of equal ability and power. On his disconnection with this paper, he became a contributor to the *New York Mirror*, and the literary weekly press. Since that period, and during the last ten years, he has written but little, except anonymously, and is understood to have chiefly devoted his attention to chemistry and the physical sciences, in which his anonymous productions have been very numerous. But he has written, and still writes, upon a great diversity of subjects. He is now about fifty years of age, and has a numerous family.

Mr. Poe, from whose critical memoir of him we have here frequently quoted, says of his style—"His prose style is noticeable for its concision, luminousness, completeness—each quality in its proper place. He has that *method* so generally characteristic of genius proper. Every thing he writes is a model, in its peculiar way—serving just the purposes intended, and nothing to spare. He has written some poetry,

which, from certain radical misapprehensions, is not very good." But this capricious critic elsewhere has said—"His poetry, if cultivated, would make the literary fame of at least half of the poets of the country." Of his prose, however, the reader will be able to judge for himself, from the specimen to which he is now at length introduced. Of the aggregate amount of his productions, it has been calculated that, independently of editorials, occasional pamphlets, and other fugitive matter, it would present, if collected, an extensive array of volumes.

GREAT

ASTRONOMICAL DISCOVERIES

LATELY MADE BY

SIR JOHN HERSCHEL, LL.D. F.R.S. &c.

AT THE

CAPE OF GOOD HOPE.

[FIRST PUBLISHED IN THE NEW YORK SUN, FROM THE SUPPLEMENT TO THE EDINBURGH JOURNAL OF SCIENCE.]

GREAT

ASTRONOMICAL DISCOVERIES.

In this unusual addition to our journal, we have the happiness of making known to the British public, and thence to the whole civilized world, recent discoveries in astronomy which will build an imperishable monument to the age in which we live, and confer upon the present generation of the human race a proud distinction through all future time. It has been poetically said that "the stars of heaven are the hereditary regalia of man," as the intellectual sovereign of the animal creation. He may now fold the zodiac around him with a loftier consciousness of his mental supremacy.

It is impossible to contemplate any great astronomical discovery without feelings closely allied to a sensation of awe, and nearly akin to those with which a departed spirit may be supposed to discover the unknown realities of a future state. Bound by the irrevocable laws of nature to the globe on which we live—creatures "close shut up in infinite expanse"

—it seems like acquiring a fearful supernatural power when any of the remote and mysterious works of the Creator yield tribute to our curiosity. It seems almost a presumptuous usurpation of powers denied us by the Divine will, when man, in the pride and confidence of his skill, steps forth, far beyond the apparently natural boundary of his privileges, and demands the secrets and familiar fellowship of other worlds. We are assured that when the immortal philosopher, to whom mankind is indebted for the thrilling wonders now first made known, had at length adjusted his new and stupendous apparatus with a certainty of success, he solemnly paused several hours before he commenced his observations, that he might prepare his own mind for discoveries which he knew would fill the minds of myriads of his fellow-men with astonishment, and secure his name a bright, if not transcendent, conjunction with that of his venerable father, to all posterity. And well might he pause! From the hour the first human pair opened their eyes to the glories of the blue firmament above them, there has been no accession to human knowledge at all comparable in sublime interest to that which he has been the honored agent in supplying; and we are taught to believe that, when a work, already preparing for the press, in which his discoveries are embodied in detail, shall be laid before the public, they will be found of incomparable importance to some of the grandest op-

erations of civilized life. Well might he pause! He was about to become the sole depositary of wondrous secrets, which had been hid from the eyes of all men that had lived since the birth of time. He was about to crown himself with a diadem of knowledge which would give him a conscious pre-eminence above every individual of his species who then lived, or who had lived in the generations that are passed away. He paused ere he broke the seal of the casket which contained it.

To render our enthusiasm intelligible, we will state at once, that by means of a telescope, of vast dimensions and an entirely new principle, the younger Herschel, at his observatory in the Southern Hemisphere, has already made the most extraordinary discoveries in every planet of our solar system; has discovered planets in other solar systems; has obtained a distinct view of objects in the moon, fully equal to that which the unaided eye commands of terrestrial objects at the distance of a hundred yards; has affirmatively settled the question whether this satellite be inhabited, and by what orders of beings; has firmly established a new theory of cometary phenomena; and has solved or corrected nearly every leading problem of mathematical astronomy.

For our early and almost exclusive information concerning these facts, we are indebted to the devoted friendship of Dr. Andrew Grant, the pupil of the elder, and for several years past the inseparable

coadjutor of the younger Herschel. The amanuensis of the latter at the Cape of Good Hope, and the indefatigable superintendent of his telescope during the whole period of its construction and operation; Dr. Grant has been enabled to supply us with intelligence equal, in general interest at least, to that which Dr. Herschel himself has transmitted to the Royal Society. Indeed our correspondent assures us that the voluminous documents now before a committee of that institution, contain little more than details and mathematical illustrations of the facts communicated to us in his own ample correspondence. For permission to indulge his friendship in communicating this invaluable information to us, Dr. Grant and ourselves are indebted to the magnanimity of Dr. Herschel, who, far above all mercenary considerations, has thus signally honored and rewarded his fellow-laborer in the field of science. The following engravings of lunar animals and other objects, and of the phases of the several planets, are accurate copies of drawings taken in the observatory by Herbert Home, Esq., who accompanied the last powerful series of reflectors from London to the Cape, and superintended their erection; and he has thus recorded the proofs of their triumphant success. The engravings of the belts of Jupiter is a reduced copy of an imperial folio drawing by Dr. Herschel himself, and contains the results of his latest observation of that planet. The segment of the inner

ring of Saturn is from a large drawing by Dr. Grant.

We first avail ourselves of the documents which contain a description and history of the instrument by which these stupendous discoveries have been made. A knowledge of the one is almost essential to the credibility of the other.

THE YOUNGER HERSCHEL'S TELESCOPE.

It is well known that the great reflecting telescope of the late elder Herschel, with an object-glass four feet in diameter, and a tube forty feet in length, possesses a magnifying power of more than six thousand times. But a small portion only of this power was ever advantageously applied to the nearer astronomical objects; for the deficiency of light from objects so highly magnified, rendered them less distinct than when viewed with a power of a third or fourth of this extent. Accordingly the powers which he generally applied when observing the moon and planets, and with which he made his most interesting discoveries, ranged from 220, 460, 750, and 900 times: although, when inspecting the double and treble fixed stars, and the more distant nebulæ, he frequently applied the full capacity of his instrument. The law of optics, that an object becomes dim in proportion as it is magnified, seemed, from its exemplification in this powerful telescope, to form an insuperable boundary to further discoveries in our solar system.

Several years, however, prior to the death of this venerable astronomer, he conceived it practicable to construct an improved series of parabolic and spherical reflectors, which, by uniting all the meritorious points in the Gregorian and Newtonian instruments, with the highly interesting achromatic discovery of Dolland, would, to a great degree, remove the formidable obstruction. His plan evinced the most profound research in optical science, and the most dexterous ingenuity in mechanical contrivance; but accumulating infirmities, and eventually death, prevented its experimental application. His son, the present Sir John Herschel, who had been nursed and cradled in the observatory, and a practical astronomer from his boyhood, was so fully convinced of the value of the theory, that he determined upon testing it, at whatever cost. Within two years of his father's death he completed his new apparatus, and adapted it to the old telescope with nearly perfect success. He found that the magnifying power of 6000 times, when applied to the moon, which was the severest criterion that could be selected, produced, under these new reflectors, a focal object of exquisite distinctness, free from every achromatic obscurity, and containing the highest degree of light which the great speculum could collect from that luminary.

The enlargement of the angle of vision which was thus acquired, is ascertained by dividing the moon's distance from the observatory, by the magnifying

power of the instrument; and the former being 240,000 miles, and the latter 6000 times, leaves a quotient of 40 miles as the apparent distance of that planet from the eye of the observer. Now it is well known that no terrestrial objects can be seen at a greater distance than this, with the naked eye, even from the most favorable elevations. The rotundity of the earth prevents a more distant view than this with the most acute natural vision, and from the highest eminences; and, generally, objects seen at this distance are themselves elevated on mountainous ridges. It is not pretended, moreover, that this forty miles telescopic view of the moon presented its objects with equal distinctness, though it did in equal size to those of this earth, so remotely stationed.

The elder Herschel had nevertheless demonstrated, that with a power of 1000 times, he could discern objects in this satellite of not more than 122 yards in diameter. If, therefore, the full capability of the instrument had been elicited by the new apparatus of reflectors constructed by his son, it would follow, in mathematical ratio, that objects could be discerned of not more than 22 yards in diameter. Yet in either case they would be seen as mere feeble, shapeless points, with no greater conspicuity than they would exhibit upon earth to the unaided eye at the distance of forty miles. But although the rotundity of the earth presented no obstruction to a view of these astronomical objects, we believe Sir John Herschel

never insisted that he had carried out these extreme powers of the telescope in so full a ratio. The deficiency of light, though greatly economized and concentrated, still maintained some inverse proportion to the magnitude of the focal image. The advance he had made in the knowledge of this planet, though magnificent and sublime, was thus but partial and unsatisfactory. He was, it is true, enabled to confirm some discoveries of former observers, and to confute those of others. The existence of volcanoes discovered by his father and by Schroeter of Berlin, and the changes observed by the latter in the volcano in the *Mare Crisium*, or Lucid Lake, were corroborated and illustrated, as was also the prevalence of far more extensive volcanic phenomena. The disproportionate height attributed to the lunar mountains was corrected from careful admeasurement; whilst the celebrated conical hills, encircling valleys of vast diameter, and surrounding the lofty central hills, were distinctly perceived. The formation which Professor Frauenhofer uncharitably conjectured to be a lunar fortification, he ascertained to be a tabular buttress of a remarkably pyramidical mountain; lines which had been whimsically pronounced roads and canals, he found to be keen ridges of singularly regular rows of hills; and that which Schroeter imagined to be a great city in the neighborhood of *Marius*, he determined to be a valley of disjointed rocks scattered in fragments, which averaged at least

a thousand yards in diameter. Thus the general geography of the planet, in its grand outlines of cape, continent, mountain, ocean, and island, was surveyed with greater particularity and accuracy than by any previous observer; and the striking dissimilarity of many of its local features to any existing on our own globe, was clearly demonstrated. The best enlarged maps of that luminary which have been published were constructed from this survey; and neither the astronomer nor the public ventured to hope for any great accession to their developments. The utmost powers of the largest telescope in the world had been exerted in a new and felicitous manner to obtain them, and there was no reasonable expectation that a larger one would ever be constructed, or that it could be advantageously used if it were. A law of nature, and the finitude of human skill, seemed united in inflexible opposition to any further improvement in telescopic science, as applicable to the known planets and satellites of the solar system. For unless the sun could be prevailed upon to extend a more liberal allowance of light to these bodies, and they be induced to transfer it, for the generous gratification of our curiosity, what adequate substitute could be obtained? Telescopes do not create light, they cannot even transmit unimpaired that which they receive. That any thing further could be derived from human skill in the construction of instruments, the labors of his illustrious predecessors,

and his own, left the son of Herschel no reason to hope. Huygens, Fontana, Gregory, Newton, Hadley, Bird, Short, Dolland, Herschel, and many others, all practical opticians, had resorted to every material in anywise adapted to the composition either of lenses or reflectors; and had exhausted every law of vision which their study had developed and demonstrated. In the construction of his last amazing specula, Sir John Herschel had selected the most approved amalgams that the advanced stage of metallic chemistry had combined; and had watched their growing brightness under the hands of the artificer with more anxious hope than ever lover watched the eye of his mistress; and he had nothing further to expect than they had accomplished. He had the satisfaction to know, that if he could leap astride a cannon ball, and travel upon its wings of fury for the respectable period of several millions of years, he would not obtain a more enlarged view of the distant stars, than he could now possess in a few minutes of time; and that it would require an ultra railroad speed of fifty miles an hour, for nearly the live-long year, to secure him a more favorable inspection of the gentle luminary of night. The interesting question, however, whether this light of the solemn forest, of the treeless desert, and of the deep blue ocean as it rolls; whether this object of the lonely turret, of the uplifted eye on the deserted battle-field, and of all the pilgrims of love and hope,

of misery and despair, that have journeyed over the hills and valleys of this earth, through all the eras of its unwritten history to those of its present voluminous record; the exciting question, whether this "observed" of all the sons of men, from the days of Eden to those of Edinburgh, be inhabited by beings, like ourselves, of consciousness and curiosity, was left for solution to the benevolent index of natural analogy, or to the severe tradition that it is tenanted only by the hoary solitaire whom the criminal code of the nursery had banished thither for collecting fuel on the Sabbath-day.

The limits of discovery in the planetary bodies, and in this one especially, thus seemed to be immutably fixed; and no expectation was elevated for a period of several years. But, about three years ago, in the course of a conversational discussion with Sir David Brewster upon the merits of some ingenious suggestions by the latter, in his article on optics in the Edinburgh Encyclopedia (p. 644), for improvements in the Newtonian reflectors, Sir John Herschel adverted to the convenient simplicity of the old astronomical telescopes that were without tubes, and the object-glass of which, placed upon a high pole, threw its focal image to a distance of 150, and even 200 feet. Dr. Brewster readily admitted that a tube was not necessary, provided the focal image were conveyed into a dark apartment, and there properly received by reflectors. Sir John then said that, if

his father's great telescope, the tube alone of which, though formed of the lightest suitable materials, weighed 3000 lbs., possessed an easy and steady mobility with its heavy observatory attached, an observatory movable without the incumbrance of such a tube was obviously practicable. This also was admitted, and the conversation became directed to that all-invincible enemy, the paucity of light in powerful magnifiers. After a few moments silent thought, Sir John diffidently inquired whether it would not be possible to effect *a transfusion of artificial light through the focal object of vision!* Sir David, somewhat startled at the originality of the idea, paused a while, and then hesitatingly referred to the refrangibility of rays and the angle of incidence. Sir John, grown more confident, adduced the example of the Newtonian reflector, in which the refrangibility was corrected by the second speculum, and the angle of incidence restored by the third. "And," continued he, "why cannot the illuminated microscope, say the hydro-oxygen, be applied to render distinct, and if necessary, even to magnify the focal object?" Sir David sprung from his chair in an ecstasy of conviction, and leaping half-way to the ceiling, exclaimed, "Thou art the man!" Each philosopher anticipated the other in presenting the prompt illustration, that if the rays of the hydro-oxygen microscope, passed through a drop of water containing the larvæ of a gnat and other objects invisible to the naked eye,

rendered them not only keenly distinct, but firmly magnified to dimensions of many feet; so could the same artificial light, passed through the faintest focal object of a telescope, both distinctify (to coin a new word for an extraordinary occasion) and magnify its feeblest component members. The only apparent desideratum was a recipient for the focal image which should transfer it, without refranging it, to the surface on which it was to be viewed under the revivifying light of the microscopic reflectors. In the various experiments made during the few following weeks, the co-operative philosophers decided that a medium of the purest plate glass (which it is said they obtained, by consent, be it observed, from the shop window of Mons. Desanges, the jeweller to his ex-majesty Charles X., in High-street) was the most eligible they could discover. It answered perfectly with a telescope which magnified 100 times, and a microscope of about thrice that power.

Sir John Herschel then conceived the stupendous fabric of his present telescope. The power of his father's instrument would still leave him distant from his favorite planet nearly forty miles; and he resolved to attempt a greater magnifier. Money, the wings of science as the sinews of war, seemed the only requisite, and even the acquisition of this, which is often more difficult than the task of Sisyphus, he determined to achieve. Fully sanctioned by the high optical authority of Sir David Brewster, he laid his

plan before the Royal Society, and particularly directed to it the attention of the President, His Royal Highness the Duke of Sussex, the ever munificent patron of science and the arts. It was immediately and enthusiastically approved by the committee chosen to investigate it, and the chairman, who was the Royal President, subscribed his name for a contribution of £10,000, with a promise that he would zealously submit the proposed instrument as a fit object for the patronage of the privy purse. He did so without delay, and his Majesty, on being informed that the estimated expense was £70,000, naively inquired if the costly instrument would conduce to any improvement in *navigation*? On being informed that it undoubtedly would, the sailor king promised a *carte blanche* for the amount which might be required.

Sir John Herschel had submitted his plans and calculations in adaption to an object-glass of twenty-four feet in diameter: just six times the size of his venerable father's. For casting this ponderous mass, he selected the large glass-house of Messrs. Hartly & Grant (the brother of our invaluable friend Dr. Grant), at Dumbarton. The material chosen was an amalgamation of two parts of the best crown with one of flint glass, the use of which, in separate lenses, constituted the great achromatic discovery of Dolland. It had been found, however, by accurate experiments, that the amalgam would as completely

triumph over every impediment, both from refrangibility and discoloration, as the separate lenses. Five furnaces of the metal, carefully collected from productions of the manufactory, in both the kinds of glass, and known to be respectively of nearly perfectly homogeneous quality, were united, by one grand conductor, to the mould; and on the 3d of January, 1833, the first cast was effected. After cooling eight days, the mould was opened, and the glass found to be greatly flawed within eighteen inches of the centre. Notwithstanding this failure, a new glass was more carefully cast on the 27th of the same month, which on being opened during the first week of February, was found to be immaculately perfect, with the exception of two slight flaws so near the line of its circumference that they would be covered by the copper ring in which it was designed to be inclosed.

The weight of this prodigious lens was 14,826 lbs., or nearly seven tons, after being polished; and its estimated magnifying power 42,000 times. It was therefore presumed to be capable of representing objects in our lunar satellite of but little more than eighteen inches in diameter, provided its focal image of them could be rendered distinct by the transfusion of artificial light. It was not, however, upon the mere illuminating power of the hydro-oxygen microscope, as applied to the focal pictures of this lens, that the younger Herschel depended for the realiza-

tion of his ambitious theories and hopes. He calculated largely upon the almost illimitable applicability of this instrument as a second magnifier, which would supersede the use, and infinitely transcend the powers of the highest magnifiers in reflecting telescopes.

So sanguinely indeed did he calculate upon the advantages of this splendid alliance, that he expressed confidence in his ultimate ability to study even the entomology of the moon, in case she contained insects upon her surface. Having witnessed the completion of this great lens, and its safe transportation to the metropolis, his next care was the construction of a suitable microscope, and of the mechanical frame-work for the horizontal and vertical action of the whole. His plans, in every branch of his undertaking, having been intensely studied, even to their minutest details, were easily and rapidly executed. He awaited only the appointed period at which he was to convey his magnificent apparatus to its destination.

A correspondence had for some time passed between the Boards of Longitude of England, France, and Austria, with a view to improvements in the tables of longitude in the southern hemisphere; which are found to be much less accurate than those of the northern. The high opinion entertained by the British Board of Longitude of the principles of the new telescope, and of the profound skill of its

inventor, determined the government to solicit his services in observing the transit of Mercury over the sun's disk, which will take place on the 7th of November in the present year; and which, as it will occur at 7h. 47m. 55s. night, conjunction, mean time; and at 8h. 12m. 22s. middle, true time, will be invisible to nearly all the northern hemisphere. The place at which the transits both of Mercury and of Venus have generally been observed by the astronomers of Europe, when occurring under these circumstances, is the Cape of Good Hope; and no transit of Venus having occurred since the year 1769, and none being to occur before 1874, the accurate observation of the transits of Mercury, which occur more frequently, has been found of great importance both to astronomy and navigation. To the latter useful art, indeed, the transits of Mercury are nearly as important as those of Venus; for although those of the latter planet have the peculiar advantage of determining exactly the great solar parallax, and thence the distances of all the planets from the sun, yet the transits of Mercury, by exactly determining the place of its own node, independently of the parallax of the great orb, determine the parallax of the earth and moon; and are therefore especially valuable in lunar observations of longitude. The Cape of Good Hope has been found preferable, in these observations, to any other station in the hemisphere. The expedition which went to Peru, about the middle of the last

century, to ascertain, in conjunction with another in Lapland, the true figure of the earth, found the attraction of the mountainous regions so strong as to cause the plumb-line of one of their large instruments to deflect seven or eight seconds from the true perpendicular; whilst the elevated plains at the Cape unite all the advantages of a lucid atmosphere with an entire freedom from mountainous obstruction. Sir John Herschel, therefore, not only accepted the appointment with high satisfaction, but requested that it might commence at least a year before the period of the transit, to afford him time to bring his ponderous and complicated machinery into perfect adjustment, and to extend his knowledge of the southern constellations.

His wish was immediately assented to, and his arrangements being completed, he sailed from London on the 4th of September, 1834, in company with Dr. Andrew Grant, Lieut. Drummond, of the Royal Engineers, F. R. A. S., and a large party of the best English mechanics. They arrived, after an expeditious and agreeable passage, and immediately proceeded to transport the lens, and the frame of the large observatory, to its destined site, which was a piece of table-land of great extent and elevation, about thirty-five miles to the northeast of Capetown; and which is said to be the very spot on which De la Caille, in 1750, constructed his invaluable solar tables, when he measured a degree of the meridian,

and made a great advance to exactitude in computing the solar parallax from that of Mars and the moon. Sir John accomplished the ascent to the plains by means of two relief teams of oxen, of eighteen each, in about four days; and, aided by several companies of Dutch boors, proceeded at once to the erection of his gigantic fabric.

The ground plan of the structure is in some respects similar to that of the Herschel telescope in England, except that instead of circular foundations of brickwork, it consists of a series of parallel circles of railroad iron, upon wooden frame-work; so constructed that the turn-outs, or rather turn-ins, from the largest circle, will conduct the observatory, which moves upon them, to the innermost circle, which is the basis of the lens-works; and to each of the circles that intervene. The diameter of the smallest circle is twenty-eight feet: that of the largest our correspondent has singularly forgotten to state, though it may be in some measure computed from the angle of incidence projected by the lens, and the space occupied by the observatory. The latter is a wooden building fifty feet square and as many high, with a flat roof and gutters of thin copper. Through the side proximate to the lens is an aperture four feet in diameter, to receive its rays, and through the roof another for the same purpose in meridional observations. The lens, which is inclosed in a square frame of wood, and braced to its corners by bars of

copper, is suspended upon an axis between two pillars, which are nearly as high as those which supported the celebrated quadrant of Uleg Beg, being one hundred and fifty feet. These are united at the top and bottom by cross-pieces, and strengthened by a number of diagonal braces; and between them is a double capstan for hoisting the lens from its horizontal line with the observatory to the height required by its focal distance when turned to the meridian; and for elevating it to any intermediate degree of altitude that may be needed. This last operation is beautifully regulated by an immense double sextant, which is connected and moves with the axis of the lens, and is regularly divided into degrees, minutes, and seconds; and the horizontal circles of the observatory being also divided into 360 degrees, and minutely subdivided, the whole instrument has the powers and regularity of the most improved theodolite. Having no tube, it is connected with the observatory by two horizontal levers, which pass underneath the floor of that building from the circular basis of the pillars: thus keeping the lens always square with the observatory, and securing to both a uniform and simple movement. By means of these levers, too, and a rack and windlass, the observatory is brought to any degree of approximation to the pillars that the altitude of an observation may require; and although, when at its nearest station it cannot command an observation with the great lens

within about fifteen degrees of the meridian, it is supplied with an excellent telescope of vast power, constructed by the elder Herschel, by which every higher degree can be surveyed. The field of view, therefore, whether exhibited on the floor or on the wall of the apartment, has a diameter of nearly fifty feet, and, being circular, it has therefore an area of nearly 1875 feet. The place of all the horizontal movements having been accurately levelled by Lieut. Drummond, with the improved level of his invention which bears his name, and the wheels both of the observatory and of the lens-works being facilitated by friction-rollers in patent axle-boxes filled with oil, the strength of one man applied to the extremity of the levers is sufficient to propel the whole structure upon either of the railroad circles; and that of two men applied to the windlass is fully adequate to bring the observatory to the basis of the pillars. Both of those movements, however, are now effected by a locomotive apparatus commanded within the apartment by a single person, and showing, by means of an ingenious index, every inch of progression or retrogression.

We have not thus particularly described the telescope of the younger Herschel because we consider it the most magnificent specimen of philosophical mechanism of the present or any previous age, but because we deemed an explicit description of its principles and powers an almost indispensable intro-

duction to a statement of the sublime expansion of human knowledge which it has achieved. It was not fully completed until the latter part of December, when the series of large reflectors for the microscope arrived from England; and it was brought into operation during the first week of the ensuing month and year. But the secrecy which had been maintained with regard to its novelty, its manufacture and its destination, was not less rigidly preserved for several months respecting the grandeur of its success. Whether the British government were skeptical concerning the promised splendor of its discoveries, or wished them to be scrupulously veiled until they had accumulated a full-orbed glory for the nation and reign in which they originated, is a question which we can only conjecturally solve. But certain it is that the astronomer's royal patrons enjoined a masonic taciturnity upon him and his friends until he should have officially communicated the results of his great experiment. Accordingly, the world heard nothing of him or his expedition until it was announced a few months since in the scientific journals of Germany, that Sir John Herschel, at the Cape of Good Hope, had written to the astronomer-royal of Vienna, to inform him that the portentous comet predicted for the year 1835, which was to approach so near this trembling globe that we might hear the roaring of its fires, had turned upon another scent, and would not even shake a hair of its tail upon our hunting-

grounds. At a loss to conceive by what extra authority he had made so bold a declaration, the men of science in Europe who were not acquainted with his secret, regarded his "postponement," as his discovery was termed, with incredulous contumely, and continued to terrorize upon the strength of former predictions.

NEW LUNAR DISCOVERIES.

Until the 10th of January, the observations were chiefly directed to the stars in the southern signs, in which, without the aid of the hydro-oxygen reflectors, a countless number of new stars and nebulæ were discovered. But we shall defer our correspondent's account of these to future pages, for the purpose of no longer withholding from our readers the more generally and highly interesting discoveries which were made in the lunar world. And for this purpose, too, we shall defer Dr. Grant's elaborate mathematical details of the corrections which Sir John Herschel has made in the best tables of the moon's tropical, sidereal, and synodic revolutions, and of those phenomena of the syzygies on which a great part of the established lunar theory depends.

It was about half past nine o'clock on the night of the 10th, the moon having then advanced within four days of her mean libration, that the astronomer adjusted his instruments for the inspection of her eastern limb. The whole immense power of his tele-

scope was applied, and to its focal image about one-half of the power of his microscope. On removing the screen of the latter, the field of view was covered throughout its entire area with a beautifully distinct, and even vivid representation of *basaltic rock*. Its color was a greenish brown, and the width of the columns, as defined by their interstices on the canvas, was invariably twenty-eight inches. No fracture whatever appeared in the mass first presented, but in a few seconds a shelving pile appeared of five or six columns width, which showed their figure to be hexagonal, and their articulations similar to those of the basaltic formation at Staffa. This precipitous shelf was profusely covered with a dark red flower, "precisely similar," says Dr. Grant, "to the *papaver rhœas*, or rose-poppy of our sublunary cornfield; and this was the first organic production of nature, in a foreign world, ever revealed to the eyes of men."

The rapidity of the moon's ascension, or rather of the earth's diurnal rotation, being nearly equal to five hundred yards in a second, would have effectually prevented the inspection, or even the discovery of objects so minute as these, but for the admirable mechanism which constantly regulates, under the guidance of the sextant, the required altitude of the lens. But its operation was found to be so consummately perfect, that the observers could detain the object upon the field of view for any period they might desire. The specimen of lunar vegetation,

however, which they had already seen, had decided a question of too exciting an interest to induce them to retard its exit. It had demonstrated that the moon has an atmosphere constituted similarly to our own, and capable of sustaining organized, and therefore, most probably, animal life. The basaltic rocks continued to pass over the inclined canvas plane, through three successive diameters, when a verdant declivity of great beauty appeared, which occupied two more. This was preceded by another mass of nearly the former height, at the base of which they were at length delighted to perceive that novelty, a lunar forest. "The trees," says Dr. Grant, "for a period of ten minutes, were of one unvaried kind, and unlike any I have seen, except the largest class of yews in the English church-yards, which they in some respects resemble. These were followed by a level green plain, which, as measured by the painted circle on our canvas of forty-nine feet, must have been more than half a mile in breadth; and then appeared as fine a forest of firs, unequivocal firs, as I have ever seen cherished in the bosom of my native mountains. Wearied with the long continuance of these, we greatly reduced the magnifying power of the microscope, without eclipsing either of the reflectors, and immediately perceived that we had been insensibly descending, as it were, a mountainous district of a highly diversified and romantic character, and that we were on the verge of a lake,

or inland sea; but of what relative locality or extent, we were yet too greatly magnified to determine. On introducing the feeblest achromatic lens we possessed, we found that the water, whose boundary we had just discovered, answered in general outline to the Mare Nubium of Riccoli, by which we detected that, instead of commencing, as we supposed, on the eastern longitude of the planet, some delay in the elevation of the great lens had thrown us nearly upon the axis of her equator. However, as she was a free country, and we not, as yet, attached to any particular province, and moreover, since we could at any moment occupy our intended position, we again slid in our magic lenses to survey the shores of the Mare Nubium. Why Riccoli so termed it, unless in ridicule of Cleomedes, I know not; for fairer shores never angel coasted on a tour of pleasure. A beach of brilliant white sand, girt with wild castellated rocks, apparently of green marble, varied at chasms, occurring every two or three hundred feet, with grotesque blocks of chalk or gypsum, and feathered and festooned at the summits with the clustering foliage of unknown trees, moved along the bright wall of our apartment until we were speechless with admiration. The water, wherever we obtained a view of it, was nearly as blue as that of the deep ocean, and broke in large white billows upon the strand. The action of very high tides was quite manifest upon the face of the cliffs for more than a hundred

miles; yet, diversified as the scenery was during this and a much greater distance, we perceived no trace of animal existence, notwithstanding we could command at will a perspective or a foreground view of the whole. Mr. Holmes, indeed, pronounced some white objects of a circular form, which we saw at some distance in the interior of a cavern, to be bona fide specimens of a large cornu ammonis; but to me they appeared merely large pebbles, which had been chafed and rolled there by the tides. Our chase of animal life was not yet to be rewarded.

"Having continued this close inspection nearly two hours, during which we passed over a wide tract of country, chiefly of a rugged and apparently volcanic character; and having seen few additional varieties of vegetation, except some species of lichen, which grew everywhere in great abundance, Dr. Herschel proposed that we should take out all our lenses, give a rapid speed to the panorama, and search for some of the principal valleys known to astronomers, as the most likely method to reward our first night's observation with the discovery of animated beings. The lenses being removed, and the effulgence of our unutterably glorious reflectors left undiminished, we found, in accordance with our calculations, that our field of view comprehended about twenty-five miles of the lunar surface, with the distinctness both of outline and detail which could be procured of a terrestrial object at the distance of two and a half

miles; an optical phenomenon which you will find demonstrated in Note 5. This afforded us the best landscape views we had hitherto obtained, and although the accelerated motion was rather too great, we enjoyed them with rapture. Several of those famous valleys, which are bounded by lofty hills of so perfectly conical a form as to render them less like works of nature than of art, passed the canvas before we had time to check their flight; but presently a train of scenery met our eye, of features so entirely novel, that Dr. Herschel signalled for the lowest convenient gradation of movement. It was a lofty chain of obelisk-shaped, or very slender pyramids, standing in irregular groups, each composed of about thirty or forty spires, every one of which was perfectly square, and as accurately truncated as the finest specimens of Cornish crystal. They were of a faint lilac hue, and very resplendent. I now thought that we had assuredly fallen on productions of art; but Dr. Herschel shrewdly remarked that if the Lunarians could build thirty or forty miles of such monuments as these, we should ere now have discovered others of a less equivocal character. He pronounced them quartz formations, of probably the wine-colored amethyst species, and promised us, from these and other proofs which he had obtained of the powerful action of laws of crystallization in this planet, a rich field of mineralogical study. On introducing a lens, his conjecture was fully confirmed:

they were monstrous amethysts, of a diluted claret color, glowing in the intensest light of the sun! They varied in height from sixty to ninety feet, though we saw several of a still more incredible altitude. They were observed in a succession of valleys divided by longitudinal lines of round-breasted hills, covered with verdure and nobly undulated; but what is most remarkable, the valleys which contained these stupendous crystals were invariably barren, and covered with stones of a ferruginous hue, which were probably iron pyrites. We found that these curiosities were situated in a district elevated half a mile above the valley of the Mare Fœcunditatis, of Mayer and Riccoli; the shores of which soon hove in view. But never was a name more inappropriately bestowed. From 'Dan to Beersheba' all was barren, barren—the sea-board was entirely composed of chalk and flint, and not a vestige of vegetation could be discovered with our strongest glasses. The whole breadth of the northern extremity of this sea, which was about three hundred miles, having crossed our plane, we entered upon a wild mountainous region abounding with more extensive forests of larger trees than we had before seen—the species of which I have no good analogy to describe. In general contour they resembled our forest oak; but they were much more superb in foliage, having broad glossy leaves like those of the laurel, and tresses of yellow flowers which hung, in the open

glades, from the branches to the ground. These mountains passed, we arrived at a region which filled us with utter astonishment. It was an oval valley, surrounded, except at a narrow opening towards the south, by hills, red as the purest vermilion, and evidently crystallized; for wherever a precipitous chasm appeared—and these chasms were very frequent, and of immense depth—the perpendicular sections presented conglomerated masses of polygon crystals, evenly fitted to each other, and arranged in deep strata, which grew darker in color as they descended to the foundations of the precipices. Innumerable cascades were bursting forth from the breasts of every one of these cliffs, and some so near their summits, and with such great force, as to form arches many yards in diameter. I never was so vividly reminded of Byron's simile, 'the tail of the white horse in the Revelations.' At the foot of this boundary of hills was a perfect zone of woods surrounding the whole valley, which was about eighteen or twenty miles wide, at its greatest breadth, and about thirty in length. Small collections of trees, of every imaginable kind, were scattered about the whole luxuriant area; and here our magnifiers blest our panting hopes with specimens of conscious existence. In the shade of the woods, on the southeastern side, we beheld continuous herds of brown quadrupeds, having all the external characteristics of the bison, but more diminutive

than any species of the bos genus in our natural history. Its tail was like that of our bos grunniens; but in its semicircular horns, the hump on its shoulders, the depth of its dew-lap, and the length of its shaggy hair, it closely resembled the species to which I first compared it. It had, however, one widely distinctive feature, which we afterwards found common to nearly every lunar quadruped we have discovered; namely, a remarkable fleshy appendage over the eyes, crossing the whole breadth of the forehead and united to the ears. We could most distinctly perceive this hairy veil, which was shaped like the upper front outline of the cap known to the ladies as Mary Queen of Scots' cap, lifted and lowered by means of the ears. It immediately occurred to the acute mind of Dr. Herschel, that this was a providential contrivance to protect the eyes of the animal from the great extremes of light and darkness to which all the inhabitants of our side of the moon are periodically subjected.

"The next animal perceived would be classed on earth as a monster. It was of bluish lead-color, about the size of a goat, with a head and beard like him, and a *single horn*, slightly inclined forward from the perpendicular. The female was destitute of the horn and beard, but had a much longer tail. It was gregarious, and chiefly abounded on the acclivitous glades of the woods. In elegance of symmetry it rivalled the antelope, and like him it seemed an agile

sprightly creature running with great speed, and springing from the green turf with all the unaccountable antics of a young lamb or kitten. This beautiful creature afforded us the most exquisite amusement. The mimicry of its movements upon our white painted canvas was as faithful and luminous as that of animals within a few yards of a camera obscura, when seen pictured upon its tympan. Frequently when attempting to put our fingers upon its beard, it would suddenly bound away into oblivion, as if conscious of our earthly impertinence; but then others would appear, whom we could not prevent nibbling the herbage, say or do what we would to them.

"On examining the centre of this delightful valley, we found a large branching river, abounding with lovely islands, and water-birds of numerous kinds. A species of gray pelican was the most numerous; but a black and white crane, with unreasonably long legs and bill, were also quite common. We watched their pisciverous experiments a long time, in hopes of catching sight of a lunar fish; but although we were not gratified in this respect, we could easily guess the purpose with which they plunged their long necks so deeply beneath the water. Near the upper extremity of one of these islands, we obtained a glimpse of a strange amphibious creature of a spherical form, which rolled with great velocity across the pebbly beach, and was lost sight of in

the strong current which set off from this angle of the island. We were compelled, however, to leave this prolific valley unexplored, on account of clouds which were evidently accumulating in the lunar atmosphere, our own being perfectly translucent. But this was itself an interesting discovery, for more distant observers had questioned or denied the existence of any humid atmosphere in this planet.

"The moon being now low on her descent, Dr. Herschel inferred that the increasing refrangibility of her rays would prevent any satisfactory protraction of our labors, and our minds being actually fatigued with the excitement of the high enjoyments we had partaken, we mutually agreed to call in the assistants at the lens, and reward their vigilant attention with congratulatory bumpers of the best 'East India Particular.' It was not, however, without regret that we left the splendid valley of the red mountains, which, in compliment to the arms of our royal patron, we denominated 'the Valley of the Unicorn;' and it may be found in Blunt's map, about midway between the Mare Fœcunditatis and the Mare Nectaris."

The nights of the 11th and 12th being cloudy, were unfavorable to observation; but on those of the 13th and 14th further animal discoveries were made of the most exciting interest to every human being. We give them in the graphic language of our accomplished correspondent:—

"The astonishing and beautiful discoveries which we had made during our first night's observation, and the brilliant promise which they gave of the future, rendered every moonlight hour too precious to reconcile us to the deprivation occasioned by these two cloudy evenings; and they were not borne with strictly philosophical patience, notwithstanding that our attention was closely occupied in superintending the erection of additional props and braces to the twenty-four feet lens, which we found had somewhat vibrated in a high wind that arose on the morning of the 11th. The night of the 13th (January) was one of pearly purity and loveliness. The moon ascended the firmament in gorgeous splendor, and the stars, retiring around her, left her the unrivalled queen of the hemisphere. This being the last night but one, in the present month, during which we should have an opportunity of inspecting her western limb, on account of the libration in longitude which would thence immediately ensue, Dr. Herschel informed us that he should direct our researches to the parts numbered 2, 11, 26, and 20 in Blunt's map, and which are respectively known in the modern catalogue by the names of Endymion, Cleomedes, Langrenus, and Petavius. To the careful inspection of these, and the regions between them and the extreme western rim, he proposed to devote the whole of this highly favorable night. Taking then our twenty-five miles

breadth of her surface upon the field of view, and reducing it to a slow movement, we soon found the first very singularly shaped object of our inquiry. It is a highly mountainous district, the loftier chains of which form three narrow ovals, two of which approach each other in slender points, and are united by one mass of hills of great length and elevation thus presenting a figure similar to that of a long skein of thread, the bows of which have been gradually spread open from their connecting knot. The third oval looks also like a skein, and lies as if carelessly dropped from nature's hand in connection with the other; but that which might fancifully be supposed as having formed the second bow of this second skein, is cut open, and lies in scattered threads of smaller hills which cover a great extent of level territory. The ground plan of these mountains is so remarkable that it has been accurately represented in almost every lineal map of the moon that has been drawn; and in Blunt's, which is the best, it agrees exactly with my description. Within the grasp, as it were, of the broken bow of hills last mentioned, stands an oval-shaped mountain, inclosing a valley of an immense area, and having, on its western ridge, a volcano in a state of terrific eruption. To the northeast of this, across the broken, or what Mr. Holmes called 'the vagabond mountains,' are three other detached oblong formations, the largest and last of which is marked F in

the catalogue, and fancifully denominated the Mare Mortuum, or more commonly the 'Lake of Death.' Induced by a curiosity to divine the reason of so sombre a title, rather than by any more philosophical motive, we here first applied our hydro-oxygen magnifiers to the focal image of the great lens. Our twenty-five miles portion of this great mountain circus had comprehended the whole of its area, and of course the two conical hills which rise within it about five miles from each other; but although this breadth of view had heretofore generally presented its objects as if seen within a terrestrial distance of two and a half miles, we were, in this instance, unable to discern these central hills with any such degree of distinctness. There did not appear to be any mist or smoke around them, as in the case of the volcano which we had left in the southwest, and yet they were comparatively indistinct upon the canvas. On sliding in the gas-light lens the mystery was immediately solved. They were old craters of extinct volcanoes, from which still issued a heated, though transparent exhalation, that kept them in an apparently oscillatory or trembling motion, most unfavorable to examination. The craters of both of these hills, as nearly as we could judge under this obstruction, were about fifteen fathoms deep, devoid of any appearance of fire, and of nearly a yellowish white color throughout. The diameter of each was about nine diam-

eters of our painted circle, or nearly 450 feet; and the width of the rim surrounding them about 1000 feet; yet, notwithstanding their narrow mouths, these two chimneys of the subterranean deep had evidently filled the whole area of the valley in which they stood with the lava and ashes with which it was encumbered, and even added to the height, if not indeed caused the existence of the oval chain of mountains which surrounded it. These mountains, as subsequently measured from the level of some large lakes around them, averaged the height of 2800 feet; and Dr. Herschel conjectured from this and the vast extent of their abutments, which ran for many miles into the country around them, that these volcanoes must have been in full activity for a million of years. Lieut. Drummond, however, rather supposed that the whole area of this oval valley was but the exhausted crater of one vast volcano, which in expiring had left only these two imbecile representatives of its power. I believe Dr. Herschel himself afterwards adopted this probable theory, which is indeed confirmed by the universal geology of the planet. There is scarcely a hundred miles of her surface, not even excepting her largest seas and lakes, in which circular or oval mountainous ridges may not be easily found; and many, very many of these having numerous inclosed hills in full volcanic operation, which are now much lower than the surrounding circles, it admits of no doubt

that each of these great formations is the remains of one vast mountain, which has burnt itself out, and left only these wide foundations of its ancient grandeur. A direct proof of this is afforded in a tremendous volcano now in its prime, which I shall hereafter notice. What gave the name of 'The Lake of Death' to the annular mountain I have just described, was, I suppose, the dark appearance of the valley which it incloses, and which, to a more distant view than we obtained, certainly exhibits the general aspect of the waters on this planet. The surrounding country is fertile to excess: between this circle and No. 2 (Endymion), which we proposed first to examine, we counted not less than twelve luxuriant forests, divided by open plains, which waved in an ocean of verdure, and were probably prairies like those of North America. In three of these we discovered numerous herds of quadrupeds similar to our friends the bisons in the Valley of the Unicorn, but of much larger size; and scarcely a piece of woodland occurred in our panorama which did not dazzle our vision with flocks of white or red birds upon the wing.

"At length we carefully explored the Endymion. We found each of the three ovals volcanic and sterile within; but, without, most rich, throughout the level regions around them, in every imaginable production of a bounteous soil. Dr. Herschel has classified not less than thirty-eight species of forest trees, and

nearly twice this number of plants, found in this tract alone, which are widely different from those found in more equatorial latitudes. Of animals, he classified nine species of mammalia, and five of oviparia. Among the former is a small kind of reindeer, the elk, the moose, the horned bear, and the biped beaver. The last resembles the beaver of the earth in every other respect than in its destitution of a tail, and its invariable habit of walking upon only two feet. It carries its young in its arms like a human being, and moves with an easy gliding motion. Its huts are constructed better and higher than those of many tribes of human savages, and from the appearance of smoke in nearly all of them, there is no doubt of its being acquainted with the use of fire. Still its head and body differ only in the points stated from that of the beaver, and it was never seen except on the borders of lakes and rivers, in which it has been observed to immerse for a period of several seconds.

"Thirty degrees further south, in No. 11, or Cleomedes, is an immense annular mountain, containing three distinct craters, which have been so long extinguished that the whole valley around them, which is eleven miles in extent, is densely crowded with woods nearly to the summits of the hills. Not a rod of vacant land, except the tops of these craters, could be descried, and no living creature, except a large white bird resembling the stork. At the

southern extremity of this valley is a natural archway or cavern, 200 feet high, and 100 wide, through which runs a river that discharges itself over a precipice of gray rock 80 feet in depth, and then forms a branching stream through a beautiful champaign district for many miles. Within twenty miles of this cataract is the largest lake, or rather inland sea, that has been found throughout the seven and a half millions of square miles which this illuminated side of the moon contains. Its width, from east to west, is 198 miles, and from north to south, 266 miles. Its shape, to the northward, is not unlike that of the bay of Bengal, and it is studded with small islands, most of which are volcanic. Two of these, on the eastern side, are now violently eruptive; but our lowest magnifying power was too great to examine them with convenience, on account of the cloud of smoke and ashes which beclouded our field of view: as seen by Lieut. Drummond, through our reflecting telescope of 2000 times they exhibited great brilliancy. In a bay, on the western side of this sea, is an island 55 miles long, of a crescent form, crowded through its entire sweep with the most superb and wonderful natural beauties, both of vegetation and geology. Its hills are pinnacled with tall quartz crystals, of so rich a yellow and orange hue that we at first supposed them to be pointed flames of fire; and they spring up thus from smooth round brows of hills which are covered as with a velvet mantle.

Even in the enchanting little valleys of this winding island we could often see these splendid natural spires, mounting in the midst of deep green woods, like church steeples in the vales of Westmoreland. We here first noticed the lunar palm-tree, which differs from, that of our tropical latitudes only in the peculiarity of very large crimson flowers, instead of the spadix protruded from the common calx. We, however, perceived no fruit on any specimens we saw: a circumstance which we attempted to account for from the great (theoretical) extremes in the lunar climate. On a curious kind of tree-melon we nevertheless saw fruit in great abundance, and in every stage of inception and maturity. The general color of these woods was a dark green, though not without occasional admixtures of every tint of our forest seasons. The hectic flush of autumn was often seen kindled upon the cheek of earliest spring; and the gay drapery of summer in some places surrounded trees leafless as the victims of winter. It seemed as if all the seasons here united hands in a circle of perpetual harmony. Of animals we saw only an elegant striped quadruped about three feet high, like a miniature zebra; which was always in small herds on the green sward of the hills; and two or three kinds of long-tailed birds, which we judged to be golden and blue pheasants. On the shores, however, we saw countless multitudes of univalve shell-fish, and among them some huge flat ones, which all three of

my associates declared to be *cornu ammonæ;* and I confess I was here compelled to abandon my skeptical substitution of pebbles. The cliffs all along these shores were deeply undermined by tides; they were very cavernous, and yellow crystal stalactites, larger than a man's thigh, were shooting forth on all sides. Indeed every rood of this island appeared to be crystallized; masses of fallen crystals were found on every beach we explored, and beamed from every fractured headland. It was more like a creation of an oriental fancy than a distant variety of nature brought by the powers of science to ocular demonstration. The striking dissimilitude of this island to every other we had found on these waters, and its near proximity to the main land, led us to suppose that it must some time have been a part of it; more especially as its crescent bay embraced the first of a chain of smaller ones which ran directly thither. This first one was a pure quartz rock, about three miles in circumference, towering in naked majesty from the blue deep, without either shore or shelter. But it glowed in the sun almost like a sapphire, as did all the lesser ones of whom it seemed the king. Our theory was speedily confirmed; for all the shore of the main land was battlemented and spired with these unobtainable jewels of nature; and as we brought our field of view to include the utmost rim of the illuminated boundary of the planet, we could still see them blazing in crowded battalions as it

were, through a region of hundreds of miles. In fact we could not conjecture where this gorgeous land of enchantment terminated; for as the rotary motion of the planet bore these mountain summits from our view, we became further remote from their western boundary.

"We were admonished by this to lose no time in seeking the next proposed object of our search, the Langrenus, or No. 26, which is almost within the verge of the libration in longitude, and of which, for this reason, Dr. Herschel entertained some singular expectations.

"After a short delay in advancing the observatory upon the levers, and in regulating the lens, we found our object and surveyed it. It was a dark narrow lake seventy miles long, bounded, on the east, north, and west, by red mountains of the same character as those surrounding the Valley of the Unicorn, from which it is distant to the southwest about 160 miles. This lake, like that valley, opens to the south upon a plain not more than ten miles wide, which is here encircled by a truly magnificent amphitheatre of the loftiest order of lunar hills. For a semicircle of six miles these hills are riven, from their brow to their base, as perpendicularly as the outer walls of the Coliseum at Rome; but here exhibiting the sublime altitude of at least two thousand feet, in one smooth unbroken surface. How nature disposed of the huge mass which she thus prodigally carved out, I know

not; but certain it is that there are no fragments of it left upon the plain, which is a declivity without a single prominence except a billowy tract of woodland that runs in many a wild vagary of breadth and course to the margin of the lake. The tremendous height and expansion of this perpendicular mountain, with its bright crimson front contrasted with the fringe of forest on its brow, and the verdure of the open plain beneath, filled our canvas with a landscape unsurpassed in unique grandeur by any we had beheld. Our twenty-five miles perspective included this remarkable mountain, the plain, a part of the lake, and the last graduated summits of the range of hills by which the latter is nearly surrounded. We ardently wished that all the world could view a scene so strangely grand, and our pulse beat high with the hope of one day exhibiting it to our countrymen in some part of our native land. But we were at length compelled to destroy our picture, as a whole, for the purpose of magnifying its parts for scientific inspection. Our plain was of course immediately covered with the ruby front of this mighty amphitheatre, its tall figures, leaping cascades, and rugged caverns. As its almost interminable sweep was measured off upon the canvas, we frequently saw long lines of some yellow metal hanging from the crevices of the horizontal strata in wild net-work, or straight pendent branches. We of course concluded that this was virgin gold, and we had no as-

say-master to prove the contrary. On searching the plain, over which we had observed the woods roving in all the shapes of clouds in the sky, we were again delighted with the discovery of animals. The first observed was a quadruped with an amazingly long neck, head like a sheep, bearing two long spiral horns, white as polished ivory, and standing in perpendicular parallel to each other. Its body was like that of the deer, but its fore-legs were most disproportionally long, and its tail, which was very bushy and of a snowy whiteness, curled high over its rump, and hung two or three feet by its side. Its colors were bright bay and white in brindled patches, clearly defined, but of no regular form. It was found only in pairs, in spaces between the woods, and we had no opportunity of witnessing its speed or habits. But a few minutes only elapsed before three specimens of another animal appeared, so well known to us all that we fairly laughed at the recognition of so familiar an acquaintance in so distant a land. They were neither more nor less than three good large sheep, which would not have disgraced the farms of Leicestershire, or the shambles of Leadenhall market. With the utmost scrutiny, we could find no mark of distinction between these and those of our native soil; they had not even the appendage over the eyes, which I have described as common to lunar quadrupeds. Presently they appeared in great numbers, and on reducing the lenses, we found

them in flocks over a great part of the valley. I need not say how desirous we were of finding shepherds to these flocks, and even a man with blue apron and rolled-up sleeves would have been a welcome sight to us, if not to the sheep; but they fed in peace, lords of their own pastures, without either protector or destroyer in human shape.

"We at length approached the level opening to the lake, where the valley narrows to a mile in width, and displays scenery on both sides picturesque and romantic beyond the powers of a prose description. Imagination, borne on the wings of poetry, could alone gather similes to portray the wild sublimity of this landscape, where dark behemoth crags stood over the brows of lofty precipices, as if a rampart in the sky; and forests seemed suspended in mid-air. On the eastern side there was one soaring crag, crested with trees, which hung over in a curve like three-fourths of a Gothic arch, and being of a rich crimson color, its effect was most strange upon minds unaccustomed to the association of such grandeur with such beauty. But whilst gazing upon them in a perspective of about half a mile, we were thrilled with astonishment to perceive four successive flocks of large winged creatures, wholly unlike any kind of birds, descend with a slow even motion from the cliffs on the western side, and alight upon the plain. They were first noticed by Dr. Herschel, who exclaimed, 'Now, gentlemen, my theories against your

proofs, which you have often found a pretty even bet, we have here something worth looking at: I was confident that if ever we found beings in human shape, it would be in this longitude, and that they would be provided by their Creator with some extraordinary powers of locomotion: first exchange for my number D.' This lens being soon introduced, gave us a fine half-mile distance; and we counted three parties of these creatures, of twelve, nine, and fifteen in each, walking erect towards a small wood near the base of the eastern precipices. Certainly they *were* like human beings, for their wings had now disappeared, and their attitude in walking was both erect and dignified. Having observed them at this distance for some minutes, we introduced lens H. z., which brought them to the apparent proximity of eighty yards: the highest clear magnitude we possessed until the latter end of March, when we effected an improvement in the gas-burners. About half of the first party had passed beyond our canvas; but of all the others we had a perfectly distinct and deliberate view. They averaged four feet in height, were covered, except on the face, with short and glossy copper-colored hair, and had wings composed of a thin membrane, without hair, lying snugly upon their backs, from the top of the shoulders to the calves of the legs. The face, which was of a yellowish flesh-color, was a slight improvement upon that of the large orang-outang, being more open and

intelligent in its expression, and having a much greater expansion of forehead. The mouth, however, was very prominent, though somewhat relieved by a thick beard upon the lower jaw, and by lips far more human than those of any species of the simia genus. In general symmetry of body and limbs they were infinitely superior to the orang-outang; so much so, that, but for their long wings, Lieut. Drummond said they would look as well on a parade ground as some of the old cockney militia! The hair on the head was a darker color than that of the body, closely curled, but apparently not woolly, and arranged in two curious semicircles over the temples of the forehead. Their feet could only be seen as they were alternately lifted in walking; but, from what we could see of them in so transient a view, they appeared thin, and very protuberant at the heel.

"Whilst passing across the canvas, and whenever we afterwards saw them, these creatures were evidently engaged in conversation; their gesticulation, more particularly the varied action of their hands and arms, appeared impassioned and emphatic. We hence inferred that they were rational beings, and, although not perhaps of so high an order as others which we discovered the next month on the shores of the Bay of Rainbows, that they were capable of producing works of art and contrivance. The next view we obtained of them was still more favorable. It was on the borders of a little lake, or expanded

stream, which we then for the first time perceived running down the valley to a large lake, and having on its eastern margin a small wood. Some of these creatures had crossed this water, and were lying like spread eagles on the skirts of the wood. We could then perceive that their wings possessed great expansion, and were similar in structure to those of the bat, being a semi-transparent membrane, expanded in curvilineal divisions by means of straight radii, united at the back by the dorsal integuments. But what astonished us very much was the circumstance of this membrane being continued from the shoulders to the legs, united all the way down, though gradually decreasing in width. The wings seemed completely under the command of volition, for those of the creatures whom we saw bathing in the water, spread them instantly to their full width, waved them as ducks do theirs to shake off the water, and then as instantly closed them again in a compact form. Our further observation of the habits of these creatures, who were of both sexes, led to results so very remarkable, that I prefer they should first be laid before the public in Dr. Herschel's own work, where I have reason to know they are fully and faithfully stated, however incredulously they may be received.— * * * * * The three families then almost simultaneously spread their wings, and were lost in the dark confines of the canvas before we had time to breathe from our paralyzing aston-

ishment. We scientifically denominated them the Vespertilio-homo, or man-bat; and they are doubtless innocent and happy creatures, notwithstanding some of their amusements would but ill comport with our terrestrial notions of decorum. The valley itself we called the Ruby Coliseum, in compliment to its stupendous southern boundary, the six-mile sweep of red precipices two thousand feet high. And the night, or rather morning, being far advanced, we postponed our tour to Petavius (No. 20), until another opportunity."

We have, of course, faithfully obeyed Dr. Grant's private injunction to omit those highly curious passages in his correspondence which he wished us to suppress, although we do not clearly perceive the force of the reasons assigned for it. It is true the omitted paragraphs contain facts which would be wholly incredible to readers who do not carefully examine the principles and capacity of the instrument with which these marvellous discoveries have been made; but so will also nearly all of those which he has kindly permitted us to publish; and it was for this reason that we considered the explicit description which we have given of the telescope so important a preliminary. From these, however, and other prohibited passages, which will be published by Dr. Herschel, with the certificates of the civil and military authorities of the colony, and of several Episcopal, Wesleyan, and other ministers, who, in

the month of March last, were permitted, under stipulation of temporary secrecy, to visit the observatory, and become eye-witnesses of the wonders which they were requested to attest, we are confident his forthcoming volumes will be at once the most sublime in science, and the most intense in general interest, that ever issued from the press.

The night of the 14th displayed the moon in her mean libration, or full; but the somewhat humid state of the atmosphere being for several hours less favorable to a minute inspection than to a general survey of her surface, they were chiefly devoted to the latter purpose. But shortly after midnight the least veil of mist was dissipated, and the sky being as lucid as on the former evenings, the attention of the astronomers was arrested by the remarkable outlines of the spot marked Tycho, No. 18, in Blunt's lunar chart; and in this region they added treasures to human knowledge which angels might well desire to win. Many parts of the following extract will remain forever in the chronicles of time:

"The surface of the moon, when viewed in her mean libration, even with telescopes of very limited power, exhibits three oceans of vast breadth and circumference, independently of seven large collections of water, which may be denominated seas. Of inferior waters, discoverable by the higher classes of instruments, and usually called lakes, the number is so great that no attempt has yet been made to count

them. Indeed, such a task would be almost equal to that of enumerating the annular mountains which are found upon every part of her surface, whether composed of land or water. The largest of the three oceans occupies a considerable portion of the hemisphere between the line of her northern axis and that of her eastern equator, and even extends many degrees south of the latter. Throughout its eastern boundary, it so closely approaches that of the lunar sphere, as to leave in many places merely a fringe of illuminated mountains, which are here, therefore, strongly contradistinguished from the dark and shadowy aspect of the great deep. But peninsulas, promontories, capes, and islands, and a thousand other terrestrial figures, for which we can find no names in the poverty of *our* geographical nomenclature, are found expanding, sallying forth, or glowing in insular independence, through all the 'billowy boundlessness' of this magnificent ocean. One of the most remarkable of these is a promontory, without a name, I believe, in the lunar charts, which starts from an inland district denominated Copernicus by the old astronomers, and abounding, as we eventually discovered, with great natural curiosities. This promontory is indeed most singular. Its northern extremity is shaped much like an imperial crown, having a swelling bow, divided and tied down in its centre by a band of hills, which is united with its forehead-band or base. The two open spaces

formed by this division are two lakes, each eighty miles wide; and at the foot of these, divided from them by the band of hills last mentioned, is another lake, larger than the two together, and nearly perfectly square. This one is followed, after another hilly division, by a lake of an irregular form; and this one, yet again, by two narrow ones, divided longitudinally, which are attenuated northward to the main land. Thus this skeleton promontory of mountain ridges runs 396 miles into the ocean, with six capacious lakes inclosed within its stony ribs. Blunt's excellent lunar chart gives this great work of nature with wonderful fidelity, and I think you might accompany my description with an engraving from it, much to your reader's satisfaction. (See plate 4.)

"Next to this, the most remarkable formation in this ocean is a strikingly brilliant annular mountain of immense altitude and circumference, standing 330 miles E. S. E., commonly known as Aristarchus (No. 12), and marked in the chart as a large mountain, with a great cavity in its centre. That cavity is now, as it was probably wont to be in ancient ages, a volcanic crater, awfully rivalling our mounts Etna and Vesuvius in the most terrible epochs of their reign. Unfavorable as the state of the atmosphere was to close examination, we could easily mark its illumination of the water over a circuit of sixty miles. If we had before retained any doubt of the power of lunar volcanoes to throw fragments of their craters

so far beyond the moon's attraction that they would necessarily gravitate to this earth, and thus account for the multitudes of massive aerolites which have fallen and been found upon our surface, the view which we had of Aristarchus would have set our skepticism forever at rest. This mountain, however, though standing 300 miles in the ocean, is not absolutely insular, for it is connected with the main land by four chains of mountains which branch from it as a common centre.

"The next great ocean is situated on the western side of the meridian line, divided nearly in the midst by the line of the equator, and is about 900 miles in north and south extent. It is marked C in the catalogue, and was fancifully called the Mare Tranquilitatis. It is rather two large seas than one ocean, for it is narrowed just under the equator by a strait not more than 100 miles wide. Only three annular islands of a large size, and quite detached from its shores, are to be found within it; though several sublime volcanoes exist on its northern boundary; one of the most stupendous of which is within 120 miles of the Mare Nectaris before mentioned. Immediately contiguous to this second great ocean, and separated from it only by a concatenation of dislocated continents and islands, is the third, marked D, and known as the Mare Serenitatis. It is nearly square, being about 330 miles in length and width. But it has one most extraordinary peculiarity, which is a perfectly

straight ridge of hills, certainly not more than five miles wide, which starts in a direct line from its southern to its northern shore, dividing it exactly in the midst. This singular ridge is perfectly *sui generis*, being altogether unlike any mountain chain either on this earth or on the moon itself. It is so very keen, that its great concentration of the solar light renders it visible to small telescopes; but its character is so strikingly peculiar that we could not resist the temptation to depart from our predetermined adherence to a general survey, and examine it particularly. Our lens G x brought it within the optical distance of 800 yards, and its whole width of four or five miles snugly within that of our canvas. Nothing that we had hitherto seen more highly excited our astonishment. Believe it or believe it not, it was one entire crystallization!—its edge, throughout its whole length of 340 miles, is an acute angle of solid quartz crystal, brilliant as a piece of Derbyshire spar just brought from a mine, and containing scarcely a fracture or chasm from end to end! What a prodigious influence must our thirteen times longer globe have exercised upon this satellite, when an embryo in the womb of time, the passive subject of chemical affinity! We found that wonder and astonishment, as excited by objects in this distant world, were but modes and attributes of ignorance, which should give place to elevated expectation, and to reverential confidence in the illimitable power of the Creator.

"The dark expanse of waters to the south of the first great ocean, has often been considered a fourth; but we found it to be merely a sea of the first class, entirely surrounded by land, and much more encumbered with promontories and islands than it has been exhibited in any lunar chart. One of its promontories runs from the vicinity of Pitatus (No. 19), in a slightly curved and very narrow line, to Bullialdus (No. 22), which is merely a circular head to it, 264 miles from its starting place. This is another mountainous ring, a marine volcano, nearly burnt out, and slumbering upon its cinders. But Pitatus, standing upon a bold cape of the southern shore, is apparently exulting in the might and majesty of its fires. The atmosphere being now quite free from vapor, we introduced the magnifiers to examine a large bright circle of hills which sweep close beside the western abutments of this flaming mountain. The hills were either of snow-white marble or semi-transparent crystal, we could not distinguish which, and they bounded another of these lovely green valleys, which, however monotonous in my descriptions, are of paradisaical beauty and fertility, and like primitive Eden in the bliss of their inhabitants. Dr. Herschel here again predicated another of his sagacious theories. He said the proximity of the flaming mountain, Bullialdus, must be so great a local convenience to dwellers in this valley during the long periodical absence of solar light, as to render it a place of populous

resort for the inhabitants of all the adjacent regions more especially as its bulwark of hills afforded it an infallible security against any volcanic eruption that could occur. We therefore applied our full power to explore it, and rich indeed was our reward.

"The very first object in this valley that appeared upon our canvas was a magnificent work of art! It was a temple—a fane of devotion, or of science, which, when consecrated to the Creator, *is* devotion of the loftiest order; for it exhibits his attributes purely free from the masquerade attire and blasphemous caricature of controversial creeds, and has the seal and signature of his own hand to sanction its aspirations. It was an equi-triangular temple, built of polished sapphire, or of some resplendent blue stone, which, like it, displayed a myriad points of golden light twinkling and scintillating in the sunbeams. Our canvas, though fifty feet in diameter, was too limited to receive more than a sixth part of it at one view, and the first part that appeared was near the centre of one of its sides, being three square columns, six feet in diameter at their base, and gently tapering to a height of seventy feet. The intercolumniations were each twelve feet. We instantly reduced our magnitude so as to embrace the whole structure in one view, and then indeed it was most beautiful. The roof was composed of some yellow metal, and divided into three compartments, which were not triangular planes inclining to the

centre, but subdivided, curved, and separated, so as to represent a mass of violently agitated flames rising from a common source of conflagration, and terminating in wildly waving points. This design was too manifest, and too skilfully executed, to be mistaken for a single moment. Through a few openings in these metallic flames, we perceived a large sphere of a darker kind of metal nearly of a clouded copper-color, which they inclosed and seemingly raged around, as if hieroglyphically consuming it. This was the roof; but upon each of the three corners there was a small sphere of apparently the same metal as the large centre one, and these rested upon a kind of cornice, quite new in any order of architecture with which we are acquainted, but nevertheless exceedingly graceful and impressive. It was like a half-opened scroll, swelling off boldly from the roof, and hanging far over the walls in several convolutions. It was of the same metal as the flames, and on each of the sides of the building it was open at both ends. The columns, six on each side, were simply plain shafts, without capitals or pedestals, or any description of ornament; nor was any perceived in other parts of the edifice. It was open on each side, and seemed to contain neither seats, altars, nor offerings; but it was a light and airy structure nearly a hundred feet high from its white glistening floor to its glowing roof, and it stood upon a round green eminence on the eastern side of the valley. We

afterwards, however, discovered two others which were in every respect fac-similes of this one; but in neither did we perceive any visitants besides flocks of wild doves, which alighted upon its lustrous pinnacles. Had the devotees of these temples gone the way of all living, or were the latter merely historical monuments? What did the ingenious builders mean by the globe surrounded with flames? Did they by this record any past calamity of *their* world, or predict any future one of *ours*? I by no means despair of ultimately solving not only these but a thousand other questions which present themselves respecting the objects in this planet; for not the millionth part of her surface has yet been explored, and we have been more desirous of collecting the greatest possible number of new facts, than of indulging in speculative theories, however seductive to the imagination.

"But we had not far to seek for inhabitants of this 'Vale of the Triads.' Immediately on the outer border of the wood which surrounded, at the distance of half a mile, the eminence on which the first of these temples stood, we saw several detached assemblies of beings whom we instantly recognized to be of the same species as our winged friends of the Ruby Coliseum near the Lake Langrenus. Having adjusted the instrument for a minute examination, we found that nearly all the individuals in these groups were of a larger stature than the

former specimens, less dark in color, and in *every respect* an improved variety of the race. They were chiefly engaged in eating a large yellow fruit like a gourd, sections of which they dexterously divided with their fingers, and ate with rather uncouth voracity, throwing away the rind. A smaller red fruit, shaped like a cucumber, which we had often seen pendent from trees having a broad dark leaf, were also lying in heaps in the centre of several of the festive groups; but the only use they appeared to make of it was sucking its juice, after rolling it between the palms of their hands and nibbling off an end. They seemed to be eminently happy, and even polite, for we saw, in many instances, individuals sitting nearest these piles of fruit, select the largest and brightest specimens, and throw them archwise across the circle to some opposite friend or associate who had extracted the nutriment from those scattered around him, and which were frequently not a few. While thus engaged in their rural banquets, or in social converse, they were always seated with their knees flat upon the turf, and their feet brought evenly together in the form of a triangle. And for some mysterious reason or other this figure seemed to be an especial favorite among them; for we found that every group or social circle arranged itself in this shape before it dispersed, which was generally done at the signal of an individual who stepped into the centre and

brought his hands over his head in an acute angle. At this signal each member of the company extended his arms forward so as to form an acute horizontal angle with the extremity of the fingers. But this was not the only proof we had that they were creatures of order and subordination. * * * We had no opportunity of seeing them actually engaged in any work of industry or art; and, so far as we could judge, they spent their happy hours in collecting various fruits in the woods, in eating, flying, bathing, and loitering about upon the summits of precipices. * * * But, although evidently the highest order of animals in this rich valley, they were not its only occupants. Most of the other animals which we had discovered elsewhere, in very distant regions, were collected here; and also at least eight or nine new species of quadrupeds. The most attractive of these was a tall white stag, with lofty spreading antlers, black as ebony. We several times saw this elegant creature trot up to the seated parties of the semi-human beings I have described, and browse the herbage close beside them, without the least manifestation of fear on its part, or of notice on theirs. The universal state of amity among all classes of lunar creatures, and the apparent absence of every carnivorous or ferocious species, gave us the most refined pleasure, and doubly endeared to us this lovely nocturnal companion of our larger, but less favored world. Ever again when I 'eye the

blue vault and bless the *useful* light,' shall I recall the scenes of beauty, grandeur, and felicity I have beheld upon her surface, not 'as *through* a glass darkly, but face to face;' and never shall I think of that line of our thrice noble poet,

——'Meek Diana's crest
Sails through the azure air, an island of the blest,',

without exulting in my knowledge of its truth."

With the careful inspection of this instructive valley, and a scientific classification of its animal, vegetable, and mineral productions, the astronomers closed their labors for the night: labors rather mental than physical, and oppressive, from the extreme excitement which they naturally induced. A singular circumstance occurred the next day, which threw the telescope quite out of use for nearly a week, by which time the moon could be no longer observed that month. The great lens, which was usually lowered during the day, and placed horizontally, had, it is true, been lowered as usual, but had been inconsiderately left in a perpendicular position. Accordingly, shortly after sunrise the next morning, Dr. Herschel and his assistants, Dr. Grant, and Messrs. Drummond and Home, who slept in a bungalow, erected a short distance from the observatory circle, were awakened by the loud shouts of some Dutch farmers and domesticated Hottentots (who were passing with their oxen to agricultural labor), that the "big house" was on fire! Dr. Herschel leaped

out of bed from his brief slumbers, and, sure enough, saw his observatory enveloped in a cloud of smoke.

Luckily it had been thickly covered, within and without, with a coat of Roman plaster, or it would inevitably have been destroyed, with all its invaluable contents; but, as it was, a hole fifteen feet in circumference had been burnt completely through the "reflecting chamber" which was attached to the side of the observatory nearest the lens, through the canvas field on which had been exhibited so many wonders that will ever live in the history of mankind, and through the outer wall. So fierce was the concentration of the solar rays through the gigantic lens, that a clump of trees, standing in a line with them, was set on fire, and the plaster of the observatory-walls, all round the orifice, was vitrified to blue glass. The lens being almost immediately turned, and a brook of water being within a few hundred yards, the fire was soon extinguished, but the damage already done was not inconsiderable. The microscope lenses had fortunately been removed for the purpose of being cleaned, but several of the metallic reflectors were so fused as to be rendered useless. Masons and carpenters were procured from Cape Town with all possible dispatch, and, in about a week, the apparatus was again prepared for operation.

The moon being now invisible, Dr. Herschel directed his inquiries to the primary planets of the

system, and first to the planet Saturn. We need not say that this remarkable globe has, for many ages, been an object of the most ardent astronomical curiosity. The stupendous phenomenon of its double ring having baffled the scrutiny and conjecture of many generations of astronomers, was finally abandoned as inexplicable. It is well known that this planet is stationed in the system nine hundred millions of miles distant from the sun, and that, having the immense diameter of seventy-nine thousand miles, it is more than nine hundred times larger than the earth. Its annual revolution round the sun is not accomplished in less than twenty-nine and a half of our years, while its diurnal rotation upon its axis is performed in ten hours, sixteen minutes, or considerably less than half a terrestrial day. It has not less than seven moons, the sixth and seventh of which were discovered by the elder Herschel in 1789. It is thwarted by mysterious belts, or bands, of a yellowish tinge, and is surrounded by a double ring, the outer one of which is 204,000 miles in diameter. The outside diameter of the inner ring is 184,000 miles, and the breadth of the outer one being 7200 miles, the space between them is 2800 miles. The breadth of the inner ring is much greater than that of the other, being 20,000 miles; and its distance from the body of Saturn is more than 30,000. These rings are opaque, but so thin that their edge has not, until now, been discovered.

Sir John Herschel's most interesting discovery with regard to this planet is the demonstrated fact that these rings are composed of the fragments of two destroyed worlds, formerly belonging to our solar system, and which, on being exploded by the fall of their oceans into their fiery abysses, were gathered around the immense body of Saturn by the attraction of gravity, and yet kept from falling to its surface by the great centrifugal force created by its extraordinary rapidity on its axis. The inner ring was, therefore, the first of these destroyed worlds (the former station of which among the present asteroids is demonstrated in the argument which we subjoin), which was accordingly carried round by the rotary force, and spread forth in the manner we see. The outer ring is another world exploded in fragments, attracted by the law of gravity, as in the former case, and kept from uniting with the inner ring by the centrifugal force of the latter. But the latter, having a slower rotation than the planet, has an inferior centrifugal force, and accordingly the space between the outer and inner ring is nearly ten times less than that between the inner ring and the body of Saturn. Having ascertained the mean density of the rings, as compared with the density of the planet, Sir John Herschel has been enabled to effect the following beautiful demonstrated—[which we omit as being too mathematical for popular comprehension.—*Ed. Sun.*]

Dr. Herschel clearly ascertained that these rings are composed of rocky strata, the skeletons of former globes, lying in a state of wild and ghastly confusion, but not devoid of mountains and seas. * * * * The belts, across the body of Saturn, he has discovered to be the smoke of a number of prodigious volcanoes, mingled with tropical clouds, carried in these straight lines by the extreme velocity of the rotary motion. * * * * [And these also he has ascertained to be the causes of the belts of Jupiter. But the portion of the work which is devoted to this subject, and to the other planets, as also that which describes the astronomer's discoveries among the stars, is comparatively uninteresting to general readers, however highly it might interest others of scientific taste and mathematical acquirements.—*Ed. Sun.*]

* * * * "It was not until the new moon of the month of March that the weather proved favorable to any continued series of lunar observations; and Dr. Herschel had been too enthusiastically absorbed in reporting his brilliant discoveries in the southern constellations, and in constructing tables and catalogues of his new stars, to avail himself of the few clear nights which intervened.

"On one of these, however, Mr. Drummond, myself, and Mr. Holmes, made those discoveries near the Bay of Rainbows to which I have somewhere briefly alluded. The bay, thus fancifully denomi-

nated, is a part of the northern boundary of the first great ocean, which I have lately described, and is marked in the chart with the letter O. The tract of country which we explored on this occasion is numbered 6, 5, 8, 7, in the catalogue, and the chief mountains to which these numbers are attached are severally named Atlas, Hercules, Heraclides Verus, and Heraclides Falsus. Still further to the north of these is the island circle, called Pythagoras, and numbered 1; and yet nearer the meridian line is the mountainous district, marked R, and called the Land of Drought; Q, the Land of Hoar Frost: and certainly the name of the latter, however hypothetically bestowed, was not altogether inapplicable, for the tops of its very lofty mountains were evidently covered with snow, though the valleys surrounding them were teeming with the luxuriant fertility of midsummer.

"But the region which we first particularly inspected, was that of Heraclides Falsus (No. 7), in which we found several new species of animals, all of which were horned, and of a white or gray color; and the remains of three ancient triangular temples, which had long been in ruins. We thence traversed the country southeastward, until we arrived at Atlas (No. 6); and it was in one of the noble valleys at the foot of this mountain that we found the very superior species of the vespertilio-homo. In stature, they did not excel those last described, but they were

of infinitely greater personal beauty, and appeared, in our eyes, scarcely less lovely than the general representations of angels by the more imaginative school of painters. Their social economy seemed to be regulated by laws or ceremonies exactly like those prevailing in the Vale of the Triads, but their works of art were more numerous, and displayed a proficiency of skill quite incredible to all except actual observers. I shall, therefore, let the first detailed account of them appear in Dr. Herschel's authenticated natural history of this planet."

[This concludes the Supplement, with the exception of forty pages of illustrative and mathematical notes, which would greatly enhance the size and price of this work, without commensurably adding to its general interest.—*Ed. Sun.*]

APPENDIX.

I. AUTHENTIC DESCRIPTION OF THE MOON.

As the nearest and most conspicuous of the celestial bodies, and inferior only to the sun in the amount of light which she affords to the earth, the moon is, ever has been, and doubtless ever will be, an object of intense interest and curiosity to the successive generations of mankind.

Less difficult of steady observation and curious scrutiny than the great luminary of day, and presenting the same invariable lineaments and mysterious marks within her growing or waning disk, from age to age she, of all celestial objects, has probably the most deeply and constantly engaged the speculations of the human mind, and enriched it with the greatest amount of astronomical knowledge. Her spherical form, and the regularity of her motions and changes, must have taught the observant and thoughtful intellects of the world nearly all the cardinal principles of that science, from an early period of human existence. And although these, like all other principles of science, have been acquired by comparatively few persons in any age or nation, yet historical vestiges concur with rational inference in sustaining the opinion that those of astronomical science, above, per-

haps, all others, have been known from the remotest periods, and among the most widely distinct communities of mankind. The Pythagorean system of astronomy, which is now supposed to be identical with the modern Copernican, existed among the priesthood of Egypt long prior to what we denominate the historical period, and is ascribed by tradition to an oriental origin still more remote in time and geographical distance. The winged globes which are to be found sculptured over the gateways of the oldest Egyptian temples, attest a knowledge both of the form and the motion of the heavenly bodies; and we know from other sources, that the moon, besides being, like the sun, an object of worship, among all the ancient nations, was adopted as their chronometer, or time-keeper, regulating all their religious and agricultural festivals and ordinary affairs. An investigation of the true mythological meaning of these systems of astronomical worship never fails to surprise and delight the inquirer with vivid revelations of the amount of learning, in celestial science, which the sacerdotal orders, at least, of the most distant periods and countries must have possessed, and wielded as a potent sceptre of hierarchical and despotic sway.

That the moon must have contributed, pre-eminently, to this influential knowledge, will be evident from a brief description of her peculiar phenomena, as a planetary body. While, like the sun and stars,

the moon has an *apparent* motion from east to west, unlike them she has a real motion round the earth from west to east, which is discoverable by comparative observation. This motion may be traced every lunation, but more distinctly during the spring months, when the moon, in the first quarter, appears in a high degree of north declination, and when its crescent is sometimes visible within thirty-six hours of the change. About this period, on the second or third day of the moon's age, it will be seen in the west after sunset at a small elevation above the horizon, and exhibiting the form of a slender crescent. On the next evening it will appear at a still higher elevation at the same hour, having moved about thirteen degrees further to the east, and its crescent will appear somewhat larger. Every succeeding day it will appear at a greater elevation, and further to the east than before, and its crescent will appear larger, till about the seventh or eighth day, when it will be seen in the south when the sun is setting in the west, at which time it assumes the appearance of a semicircle, or half moon. During this period the horns of the crescent point towards the east, the enlightened part of the lunar disk being turned towards the sun. After the first quarter, or the period of half moon, the lunar orb still keeps on its course to the eastward, and the portion of its enlightened disk is gradually enlarged, till about the fifteenth day of the moon's age, when it appears as a full enlightened

hemisphere, and rises in the east about the time when the sun is setting in the west. In this position it is said to be in *opposition* to the sun, and passes the meridian about midnight. After this period the enlightened part of its disk gradually diminishes, and it rises at a later hour, till, in the course of seven days, it is again reduced to a semicircle, and is seen only during one-half of the night. Some nights after it appears reduced to a crescent, having its points or horns turned towards the *west*, the sun being then to the east of it. After this it rises but a little time before the sun, and is seen only early in the morning; and its crescent daily diminishes till it at length disappears, when it rises at the same time with the sun; and after having been invisible for two or three days, it reappears in the evening in the west a little after sunset. During this period the moon has made a complete circuit round the heavens from west to east, which is accomplished in twenty-nine days and a half, in which period it passes through all the phases now described. The progressive motion from west to east, every day, may be traced by observing the stars which lie nearly in the line of the moon's course. If a star be observed considerably to the eastward of the moon on any particular evening, on the following evening it will appear about thirteen degrees nearer the star, and will afterwards pass to the eastward of it, and every succeeding day will approach nearer to all the other stars which lie near the line of its course to the eastward.

When the new moon first appears like a slender crescent, her dark hemisphere is seen illuminated with a faint light, perceptible even to the naked eye; and with the help of a telescope we are enabled, by this faint illumination, to distinguish the prominent spots on this portion of the lunar disk. This faint light, therefore, is nothing else than the *moonlight of the moon*, produced by the earth shining with nearly a full face upon the dark surface of the moon. And as the surface of the earth is thirteen times larger than the surface of the moon, the light reflected from the earth will be nearly equal to that of thirteen full moons. As the age of the moon increases, this secondary light is gradually enfeebled, and after the seventh or eighth day from the change it is seldom visible. This arises from the diminution of the enlightened part of the earth, which then appears only like a half moon, approaching to a crescent, and, consequently, throws a more feeble light upon the moon, which is the more difficult to be perceived as the enlightened part of the moon increases.

While the moon is performing her revolution round the earth every month, she is also gradually revolving round her axis; and it is somewhat remarkable that her revolution round her own axis is performed *in the same time* as her revolution round the earth. This is inferred from the circumstance that *the moon always turns the same face to the earth*, so that we never see the other hemisphere of this globe. For if the

moon *had no rotation upon her axis*, she would present every part of her surface to the earth. This does not, at first sight, appear obvious to those who have never directed their attention to the subject. Any one, however, may convince himself of the fact by standing in the centre of a circle, and causing another person to carry round a terrestrial globe, without turning it on its axis, when he will see every part of the surface of the globe in succession; and in order that one hemisphere only should be presented to his view, he will find that the globe will require to be gradually turned round its axis, so as to make a complete rotation during the time it is carried round the circle. The axis of the moon is inclined 88° 29′ to the ecliptic, so that it is nearly perpendicular to it. Although the moon presents nearly the same side to the earth in all her revolutions around it, yet there is perceived a certain slight variation in this respect. When we look attentively at the disk of the moon with a telescope, we sometimes observe the spots on her eastern limb, which were formerly visible, concealed behind her disk, while others appear on her western limb which were not seen before. The spots which appear on the western limb withdraw themselves behind the limb, while the spots which were concealed behind the eastern limb again appear. The same phenomena are observed in the north and south limb of the moon, so that the spots sometimes change their positions about three minutes on the moon's

disk, or about the eleventh part of her diameter. This is termed *the libration of the moon;* the one her libration in *longitude*, and the other her libration in *latitude.*

From what we have stated above in relation to the phases and motions of the moon, it is evident that the moon is a dark body, like the earth, and derives all its light from the sun, for its enlightened side is always turned towards that luminary. It likewise derives a faint light by the reflection of the sun's rays from the earth, in the same way as we derive a mild light from the moon. And as the earth has an uneven surface, composed of mountains and vales; so the moon is found to be diversified with similar inequalities. It is owing to these inequalities, or the *roughness* of the moon's surface, that the light of the sun is reflected from it *in every direction;* for, if the surface of the moon were perfectly smooth, like a polished globe or speculum, her orb would be invisible to us; except, perhaps, at certain times, when the image of the sun, reflected from it, would appear like a bright lucid point.

The moon's distance from the centre of the earth is, in round numbers, 240,000 miles, or somewhat less than a quarter of a million; which is little more than the fourth part of the diameter of the sun. Small as this distance is compared with that of the other planets, it would require five hundred days, or sixteen months and a half, for a steam-carriage to

move over the interval which separates us from the lunar orb, although it were moving day and night at the rate of twenty miles every hour. In her motion round the earth every month, she pursues her course at the rate of 2300 miles an hour. But she is carried at the same time, along with the earth, round the sun every year, so that her real motion in space is much more rapid than what has now been stated; or while she accompanies the earth in its motion round the sun, which is at the rate of 68,000 miles an hour, she also moves thirteen times round the earth during the same period, which is equal to a course of nearly twenty millions of miles.

The moon's orbit is inclined to the ecliptic in an angle of 5° 9′; so that, in one part of her course, she is above, and in another below the level of the earth's orbit. It is owing to this circumstance that this orb is not eclipsed at every full moon and the sun at every new moon, which would regularly happen did the moon move in an orbit exactly coincident with the plane of the ecliptic. The moon's orbit, of course, crosses the orbit of the earth in two opposite points, called her *nodes*; and it is only when the new or full moon happens at or near these nodes that an eclipse of the sun or moon can take place; for it is only when she is in such a position that the sun, the moon, and the earth are nearly in a straight line, and that the shadow of the one can fall upon the other. The shadow of the moon falling upon any part of

the earth produces an eclipse of the sun, and the shadow of the earth falling upon the moon causes an eclipse of the moon. An eclipse of the moon can only take place at *full moon*, when the earth is between the sun and the moon; and an eclipse of the sun can only happen at *new moon*, when the moon comes between the sun and the earth. Lunar eclipses are visible in all parts of the earth which have the moon above their horizon, and are everywhere of the same magnitude and duration; but a solar eclipse is never seen throughout the whole hemisphere of the earth where the sun is visible; as the moon's disk is too small to hide the whole, or any part of the sun from the whole disk or hemisphere of the earth. Nor does an eclipse of the sun appear the same in all parts of the earth where it is visible, but when in one place it is total, in another it is only partial.

The moon's orbit, like those of the other planets, is in the form of an *ellipse*, the *eccentricity* of which is 12,960 miles, or about $\frac{1}{17}$th part of its longest diameter. The moon is, therefore, at different distances from the earth in different parts of her orbit. When at the greatest distance from the earth, she is said to be in her *apogee;* when at the least distance, in her *perigee*. The nearer the moon is to the periods of *full* or *change*, the greater is her velocity; and the nearer to the quadratures, or the periods of half moon, the slower she moves. When the earth is in its *perihelion*, or nearest the sun, the periodical time

of the moon is the greatest. The earth is at its perihelion in winter, and, consequently, at that time the moon will describe the largest circle about the earth, and her periodical time will be the longest; but when the earth is in its *aphelion*, or farthest from the sun, which happens in summer, she will describe a smaller circle, and her periodical time will be the least: all which circumstances are found to agree with observation. These and many other irregularities in the motion of this orb, which it would be too tedious to particularize, arise from the attractive influence of the sun upon the lunar orb in different circumstances and in different parts of its course, so as to produce different degrees of accelerated and retarded motion. The irregularities of the moon's motion have frequently puzzled astronomers and mathematicians, and they render the calculations of her true place in the heavens a work of considerable labor. No less than thirty equations require to be applied to the *mean* longitude in order to obtain the *true*, and about twenty-four equations for her latitude and parallax; but to enter minutely into such particulars would afford little satisfaction to general readers.

Of all the celestial bodies, the telescopic view of the moon presents the most interesting and variegated appearance. We perceive, as it were, a map or model of another world, resembling in some of its prominent features the world in which we dwell, but differing from it in many of its minute arrangements.

It bears a certain analogy to the earth in some of the mountains and vales which diversify its surface; but the general form and arrangement of these elevations and depressions, and the scenery they present to a spectator on the lunar surface, are very different from what we behold in our terrestrial landscapes. When we view the moon with a good telescope when about three days old, we perceive a number of elliptical spots with slight shadows, evidently indicating elevations and depressions; we also perceive a number of bright specks or studs in the dark hemisphere, immediately adjacent to the enlightened crescent, and the boundary between the dark and the enlightened portion of the disk appears jagged and uneven. At this time, too, we perceive the dark part of the moon covered with a faint light; so that the whole circular outline of the lunar hemisphere may be plainly discerned. When we take a view of the lunar surface, at the period of half moon, we behold a greater variety of objects, and the shadows of the mountains and caverns appear larger and more prominent. This is, on the whole, the best time for taking a telescopic view of the surface of the moon. When we view her when advanced to a gibbous phase, we see a still greater extent of the surface, but the shadows of the different objects are shorter and less distinct. At the time of full moon, no shadows either of the mountains or caverns are perceptible, but a variety of dark and bright streaks and patches appear distributed in

different shapes over all its surface. If we had no other view of the moon but at this period, we should scarcely be able to determine whether mountains and vales existed on this orb. The view of the *full* moon, therefore, however beautiful and variegated, can give us no accurate idea of the mountains, vales, caverns, and other geographical arrangements which diversify its surface.

That the surface of the moon is diversified with mountains, or high elevations, is evident from an inspection of its disk, even with a common telescope. They are recognized from various circumstances. 1. From the appearance of the boundary which separates the dark from the enlightened hemisphere of the moon. This boundary is not a straight line or a regular curve, as it would be if the moon were a perfectly smooth globe, but uniformly presents an uneven or jagged appearance, cut, as it were, into numerous notches and breaks, somewhat resembling the teeth of a saw, which appearance can only be produced by elevations and depressions on the lunar surface. 2. Adjacent to the boundary between light and darkness, and *within* the dark part of the moon, there are seen, in almost every stage of the moon's increase and decrease, a number of *shining points* like stars, completely separated from the enlightened parts, and sometimes other small spaces or streaks which join to the enlightened surface, but run out into the dark side, which gradually change their

figure till at length they come wholly within the enlightened boundary. These shining points or streaks are ascertained to be the tops or highest ridges of mountains which the sun first enlightens before his rays can reach the valleys; just as the beams of the rising sun irradiate our mountain-tops before the lower parts of the landscape are enlightened. 3. The *shadows* of the mountains, when they are fully enlightened, are distinctly seen near the border of the illuminated part of the moon, as the shadows of elevated objects are seen on the terrestrial landscape. These shadows are longest and most distinctly marked about the time of half-moon; and they grow shorter as the lunar orb advances to the period of full moon, in the same way as the shadows of terrestrial objects in summer gradually shorten as the sun approaches the meridian. These considerations demonstrate, beyond the possibility of doubt, that mountains of very considerable altitude and in vast variety of forms abound in almost every region of the moon.

The lunar mountains, in general, exhibit an arrangement and an aspect very different from the mountain scenery of our globe. They may be arranged into the four following varieties; 1. *Insulated mountains*, which rise from plains nearly level, like a sugar-loaf placed on a table, and which may be supposed to present an appearance somewhat similar to Mount Etna or the peak of Teneriffe. The

shadows of these mountains, in certain phases of the moon, are as distinctly perceived as the shadow of an upright staff when placed opposite to the sun; and their heights can be calculated from the length of their shadows. The heights and the length of the base of more than seventy of these mountains have been calculated by M. Schroeter, who had long surveyed the lunar face with powerful telescopes, and who some time ago published the result of his observations in a work entitled "Fragments of Selenography." Thirty of these insulated mountains are from two to five miles in perpendicular height; thirteen are above four miles; and about forty are from a quarter of a mile to two miles in altitude. The length of their bases varies from three and one-half to ninety-six miles in extent. Some of these mountains will present a very grand and picturesque prospect around the plains in which they stand. 2. *Ranges of mountains*, extending in length two or three hundred miles. These ranges bear a distant resemblance to our Alps, Apennines, and Andes, but they are much less in extent, and do not form a very prominent feature of the lunar surface. Some of them appear very rugged and precipitous, and the highest ranges are, in some places, above four miles in perpendicular altitude. In some instances they run nearly in a straight line from northeast to southwest, as in that range called the *Apennines;* in other cases they assume

the form of a semicircle or a crescent. 3. Another class of the lunar mountains is the *circular ranges* which appear on almost every part of the moon's surface, particularly in its southern regions. This is one of the grand peculiarities of the lunar ranges, to which we have nothing similar in our terrestrial arrangements. A plain, and sometimes a large cavity, is surrounded with a circular ridge of mountains, which encompasses it like a mighty rampart. These annular ridges and plains are of all dimensions, from a mile to forty or fifty miles in diameter, and are to be seen in great numbers over every region of the moon's surface. The mountains which form these ridges are of different elevations, from one-fifth of a mile to three and one-half miles in altitude, and their shadows sometimes cover the one half of the plain. These plains are sometimes on a level with the general surface of the moon, and in other cases they are sunk a mile or more below the level of the ground which surrounds the *exterior* circle of the mountains. In some of these circular ridges is perceived a narrow *pass* or opening, as if intended to form an easy passage or communication between the interior plain and the regions beyond the exterior of the mountains. 4. The next variety is the *central mountains*, or those which are placed in the middle of circular plains. In many of the plains and cavities surrounded by annular mountains there is an insulated mountain, which

rises from the centre of the plain, and whose shadow sometimes extends, in a pyramidal form, across the semidiameter of the plain to the opposite ridges. These central mountains are generally from half a mile to a mile and a half in perpendicular altitude. In some instances they have two and sometimes three separate tops, whose distinct shadows can be easily distinguished. Sometimes they are situated towards one side of the plain or cavity, but in the great majority of instances, their position is nearly or exactly central. The lengths of their bases vary from five to about fifteen or sixteen miles.

The most prominent and peculiar feature of the moon's surface are its prodigious caverns, which are to be seen throughout almost every region; but are most numerous in the southwest part of the moon. Nearly a hundred of them, great and small, may be distinguished in that quarter. They are all nearly of a circular shape, and appear like a very shallow egg-cup. The smaller cavities appear within almost like a hollow cone, with the sides tapering towards the centre; but the larger ones have, for the most part, flat bottoms, from the centre of which there frequently rises a small steep conical hill, which gives them a resemblance to the annular ridges and central mountains above described. In some instances their margins are level with the general surface of the moon, but in most cases they are encircled with a high annular ridge of mountains marked

with lofty peaks. Some of the larger of these cavities contain smaller cavities of the same kind and form, particularly in their sides. The mountainous ridges which surround these cavities reflect the greatest quantity of light; and hence that region of the moon in which they abound appears brighter than any other. From their lying in every possible direction, they appear, at and near the time of full moon, like a number of brilliant streaks or radiations. These radiations appear to converge towards a large brilliant spot surrounded by a faint shade, near the lower part of the moon, which is known by the name of *Tycho*, and which every one who views the full moon, even with a common telescope, may easily distinguish. In regard to their *dimensions*, they are of all sizes, from three miles to fifty miles *in diameter* at the top; and their depth below the general level of the lunar surface varies from one-third of a mile to three miles and a half. Twelve of these cavities, as measured by Schroeter, were found to be above two miles in perpendicular depth. These cavities constitute a *peculiar feature* in the scenery of the moon, and in her physical constitution, which bears scarcely any analogy to what we observe in the physical arrangements of our globe. But, however different such arrangements may appear from what we see around us in the landscapes of the earth, and however unlikely it may at first sight appear that such places should be the abode of intelligent beings,

there is no doubt that, in point of beauty, variety, and sublimity, these spacious hollows, with all their assemblage of circular and central mountain scenery, will exceed in interest and grandeur any individual scene we can contemplate on our globe. We have only to conceive that such places are diversified and adorned with all the vegetable scenery which we reckon beautiful and picturesque in a terrestrial landscape, and with objects that are calculated to reflect with brilliancy the solar rays, in order to give us an idea of the grandeur of the scene. And that the objects connected with these hollows are formed of substances fitted to reflect the rays of the sun with peculiar lustre, appears from the brilliancy which most of them exhibit when either partially or wholly enlightened; presenting to view, especially at full moon, the most luminous portions of the lunar surface, so that former astronomers were led to compare them to rocks of diamond.

From a consideration of the broken and irregular ground, and the deep caverns which appear in different parts of the moon's surface, several astronomers were led to conjecture that such irregularities were of volcanic origin. These conjectures were supposed to be confirmed by the appearance of certain luminous points, which were occasionally seen on the dark part of the moon. During the annular eclipse of the sun on the 24th of June, 1778, Don Ulloa perceived, near the northwest limb of the moon, a bright

white spot, which he imagined to be the light of the sun shining through an opening in the moon. This phenomenon continued about a minute and a quarter, and was noticed by three different observers. Beccaria observed a similar spot in 1772. M. Bode, of Berlin, M. de Villeneuve, M. Nouet, Captain Kater, and several others, at different times, observed similar phenomena, some of which had the appearance of a small nebula, or a star of the sixth magnitude, upon the dark part of the lunar disk. Sir W. Herschel, in 1787, observed similar phenomena, which he ascribes to the eruption of volcanoes. The following is an extract from his account of those phenomena: "April 19, 1787, $10^h\,36'$. I perceive three volcanoes in different places of the dark part of the new moon. Two of them are already nearly extinct, or otherwise in a state of going to break out; the third shows an eruption of fire or luminous matter. The distance of the crater from the northern limb of the moon is $3'\,57''$; its light is much brighter than the nucleus of the comet which M. Mechain discovered at Paris on the 10th of this month." "April 20, 10^h. The volcano burns with greater violence than last night; its diameter cannot be less than three seconds; and hence the shining or burning matter must be above three miles in diameter. The appearance resembles a small piece of burning charcoal when it is covered by a very thin coat of white ashes, and it has a degree of brightness about as strong as that with which

such a coal would be seen to glow in faint daylight."

Whether there be any large masses of water in the moon amounting to oceans, seas, or great lakes, is a question which has engaged the attention of astronomers, and which demands a few remarks. When we view the moon through a good telescope, we perceive a number of large dark spots of different dimensions, some of which are visible to the naked eye. These spots, in the early observations of the moon with telescopes, were generally supposed to be large collections of water similar to our seas, and the names given them by Hevelius, such as *Mare Crisium*, *Mare Imbrium*, &c., are founded on this opinion. The general smoothness of these obscure regions, and the consideration that water reflects less light than the land, induced some astronomers to draw this conclusion. But there appears no solid ground for entertaining such an opinion; for, in the first place, when these dark spots are viewed with good telescopes, they are found to contain numbers of cavities, whose shadows are distinctly perceived falling within them, which can never happen in a sea or smooth liquid body; and besides, several insulated mountains, whose shadows are quite perceptible, are found here and there in these supposed seas. In the next place, when the boundary of light and darkness passes through these spots, it is not exactly

a straight line or a regular curve, as it ought to be were those parts perfectly level like a sheet of water, but appears slightly jagged or uneven. There are scarcely any parts of these spots in which slight elevations may not be seen. In many of them the light and shade, indicating inequality of surface, are quite perceptible; and in certain parts ridges nearly parallel, of slight elevation, with interjacent plains, are distinctly visible. These dark spots, therefore, must be considered as *extensive plains* diversified with gentle elevations and depressions, and consisting of substances calculated to reflect the light of the sun with *a less degree of intensity* than the other parts of the lunar surface. These plains are of different dimensions, from forty or fifty to seven hundred miles in extent, and they occupy more than one third of that hemisphere of the moon which is seen from the earth, and, consequently, will contain nearly three millions of square miles. As the moon, therefore, is diversified with mountains and cavities of forms altogether different from those of our globe, so the plains upon the surface of that orb are far more varied and extensive than the generality of plains which are found on the surface of the earth. It is a globe diversified with an immense variety of mountain scenery, and, at the same time, abounding with plains and valleys of vast extent. But there appear to be no seas, oceans, or any *large* collections of water, though it is possible that small

lakes or rivers may exist on certain parts of its surface. As we see only one side of the moon from the earth, we cannot tell what objects or arrangements may exist on its opposite hemisphere, though it is probable that that hemisphere does not differ *materially* in its scenery and arrangements from those which are seen on the side which is turned towards the earth.

Whether the moon has an atmosphere, or body of air similar to that which surrounds the earth, has been a subject of dispute among astronomers. On the one side, the existence of such an atmosphere is denied, because the stars which disappear behind the body of the moon retain their full lustre till they seem to touch its very edge, and then they vanish in a moment; which phenomenon, it is supposed, would not happen if the moon were encompassed with an atmosphere. On the other hand, it has been maintained that the phenomena frequently attending eclipses of the sun furnish arguments for the existence of a lunar atmosphere. It has been observed on different occasions that the moon in a solar eclipse was surrounded with a luminous ring, which was most brilliant on the side nearest the moon; that the sharp horns of the lunar crescent have been seen blunted at their extremities during total darkness; that, preceding the emersion, a long narrow streak of dusky red light has been seen to color the western limb of the moon; and that the

circular figure of Jupiter, Saturn, and the fixed stars has been seen changed into an elliptical one when they approached either the dark or the enlightened limb of the moon; all which circumstances are considered as indications of a lunar atmosphere. The celebrated M. Schroeter, of Lilienthal, made numerous observations in order to determine this question, and many respectable astronomers are of opinion that his observations clearly prove the existence of an atmosphere around the moon. He discovered near the moon's cusps a faint gray light of a pyramidal form, extending from both cusps into the dark hemisphere, which, being the moon's twilight, must necessarily arise from its atmosphere. It would be too tedious to detail all the observations of Schroeter on this point; but the following are the general conclusions: "That the inferior or more dense part of the moon's atmosphere is not more than 1500 English feet high; and that the height of the atmosphere where it could affect the brightness of a fixed star, or inflect the solar rays, does not exceed 5742 feet," or little more than an English mile. A fixed star will pass over this space in less than two seconds of time; and if it emerge at a part of the moon's limb where there is a ridge of mountains, scarcely any obscuration can be perceptible.

On the whole, it appears most probable that the moon is surrounded with a fluid which serves the

purpose of an atmosphere, although this atmosphere, as to its nature, composition, and refractive power, may be very different from the atmosphere which surrounds the earth. It forms no proof that the moon or any of the planets is destitute of an atmosphere, because its constitution, its density, and its power of refracting the rays of light are different from ours. An atmosphere may surround a planetary body, and yet its parts be so fine and transparent that the rays of light from a star or any other body may pass through it without being in the least obscured or changing their direction. In our reasonings on this subject we too frequently proceed on the false principle that every thing connected with other worlds must bear a resemblance to those on the earth. But as we have seen that the surface of the moon, in respect to its mountains, caverns, and plains, is very differently arranged from what appears on the landscape of our globe, so we have every reason to conclude that the atmosphere with which that orb may be surrounded is materially different in its constitution and properties from that body of air in which we move and breathe; and it is highly probable, from the diversity of arrangements which exists throughout the planetary system, that the atmospheres of all the planets are variously constructed, and have properties different from each other. Whatever may be the nature of the moon's atmosphere, it is evident that nothing similar to

clouds exists in it, otherwise they would be quite perceptible by the telescope; and hence we may conclude that neither hail, snow, rain, nor tempests disturb its serenity; for all the parts uniformly present a clear, calm, and serene aspect.

II. NEW THEORY OF THE LUNAR SURFACE IN RELATION TO THAT OF THE EARTH.

About three years since, Mr. Nasmyth read to the British Association, at Edinburgh, a paper on the above subject, which was illustrated by a series of drawings executed by the aid of a powerful telescope. After calling attention to the vast number and magnitude of crater-formed mountains, with which every portion of the moon's surface appears to be covered, Mr. Nasmyth proceeded to give the reasons for the conclusion that they are really the craters of extinct lunar volcanoes, pointing out the frequent recurrence of the central cone, the result of the last eruptive efforts of an expiring volcano. The cause of the vast number of the lunar volcanoes was traced to the rapid consolidation and contraction of the crust of the moon, whose mass, being but one sixty-fourth of that of the earth, while its surface is one-sixteenth, has a radiating surface four times greater than that of the earth in relation to its bulk. In consequence, by the rapid cooling and collapse of the crust of the

moon on its molten interior, the fluid matter under the solid crust was forced to find an escape through it, and come forth in those vast actions which have produced such numbers of volcanoes. The cause of the vast magnitude of the lunar craters was also assigned to the rapid and energetic collapse of the moon's crust, the action as regards the wide dispersion of the ejected matter being enhanced by its lightness, which is caused by the much less force of gravity on the lunar than on the terrestrial surface, so that the collapse action had to operate on material probably not half the weight of cork, bulk for bulk. The vast ranges of mountains on the moon's surface Mr. Nasmyth explains by the continued progress of the collapse action of the solid crust, crushing down or following the molten interior, which, by the gradual dispersion of its heat, would retreat from contact with the interior of the solid crust, and permit it to crush down, and so force that portion of the original surface out of the way, and in consequence assume the form and arrangement of mountain ranges.

In illustration of this action, Mr. Nasmyth adduced the familiar case of the wrinkling of the surface of an apple. The mountain ranges he considers to be nothing more nor less than the material which in the original expanded globes formed the comparatively level crust of the moon and earth. The fall of the unsupported crust on the retreating nucleus was described as yielding a very probable explanation of

the appearance of granitic and igneous centres of certain mountain ranges, as well as the injection of igneous rocks in the form of trap-dikes and basaltic formations, which appear to have come forth in this manner from below the crust of the earth. The origin of the bright lines radiating from certain volcanic centres on the moon's surface was alluded to, and illustrated by the experiment of causing the surface of a glass globe filled with water to collapse on the fluid interior by rapidly contracting the surface while the water had no means of escape. The result was the splitting or cracking up of the surface in a multitude of radiating cracks, very much resembling those on the moon. This subject was further illustrated by reference to the manner in which the surface of a frozen pond may be made to crack from pressure underneath, yielding radiating cracks from the centre of convergence, where the chief discharge of water will take place, while simultaneously all along the lines of radiating cracks the water will make its appearance, thus explaining how it is that the molten material came forth from the moon simultaneously through the course of cracks, and appeared on the surface as basaltic overflow, irrespective of surface inequalities.